American Journal of Surgery

QUARTERLY SUPPLEMENT of ANESTHESIA & ANALGESIA

[American Journal of Anesthesia and Analgesia]

OFFICIAL ORGAN

American Association of Anesthetists
Inter-State Association of Anesthetists
Scottish Society of Anesthetists
New York Society of Anesthetists
Providence (R. I.) Society of Anesthetists

EDITOR

F. HOEFFER McMECHAN, A.M., M.D.

ASSOCIATES

JAMES TAYLOE GWATHMEY, M.D.,
DUDLEY W. BUXTON, M.D., M.R.C.P.,
WILLIS D. GATCH, M.D., F.A.C.S.,
JOHN D. MORTIMER, M.D., F.R.C.S.,
PROF. C. BASKERVILLE, Ph.D., F.C.S.,
ARTHUR E. HERTZLER, M.D., F.A.C.S.,
WM. HARPER DEFORD, D.D.S., M.D.,
ISABELLA C. HERB, M.D.,
CHARLES K. TETER, D.D.S.,
PROF. DR. GUIDO FISCHER,
CARROLL W. ALLEN, M.D., F.A.C.S.,
EDWARD H. EMBLEY, M.D., B.Ch.,
TORRANCE THOMSON, M.D.,
PROF. YANDELL HENDERSON, Ph.D.,
E. I. McKESSON, M.D.,
RICH. H. RIETHMÜLLER, Ph.D., D.D.S.

JULY

CONTENTS OF THIS ISSUE

1916

SURGICAL MORTALITY FROM THE STANDPOINT OF THE ANESTHETIST	H. W. Kearney, Washington, D. C.	66
ETHYL CHLORID ANESTHESIA	Ray A. Rice, Columbus, Ohio	71
SOME BASIC PRINCIPLES OF GENERAL ANESTHESIA	Carl G. Parsons, Denver, Col.	76
FACTORS OTHER THAN THE ANESTHETIC CAUSING DANGER DURING ANESTHESIA	F. D. Bullard, Los Angeles, Cal.	78
SPINAL ANESTHESIA	John Overton, Tulsa, Oklahoma	80
NITROUS OXID-OXYGEN ANESTHESIA WITH A DESCRIPTION OF A NEW APPARATUS	Albert H. Miller, Providence, R. I.	86

DEPARTMENTS

EDITORIALS - - - - - - - - 90

BOOK REVIEWS - - - - 89-91
NEWER APPARATUS - - - 95
SOCIETY PROCEEDINGS - - 92
INDEX AND ABSTRACTS - - 96

SURGICAL MORTALITY FROM THE STANDPOINT OF THE ANESTHETIST.*

H. W. KEARNEY, M.D.,
Anesthetist to the Garfield Memorial Hospital.
WASHINGTON, D. C.

The position of anesthetist is somewhat peculiar in that he may be said to be the lookout of the surgical team. His duty consists not merely in a careful administration of the anesthetic but in constantly taking soundings, so to speak, in order that the navigator of the surgical ship may be informed as to whether he proceeds in safety or approaches the shallows. Watching, weighing, analyzing, estimating, the man who sits at the head of the operating table, if he thinks at all, must necessarily receive some rather definite impressions concerning the factors influencing our surgical mortality.

In attempting to deal with impressions received in this manner the present paper may not offer anything new, but the subject of surgical mortality touches us all very closely and if this very inadequate discussion serves but to fix attention upon some things which we do not think about enough, or perhaps forget entirely, then it will have been worth while.

In our day disease must indeed be firmly and hopelessly intrenched to escape surgical attack. And certainly, with the average surgical risk and with the exercise of average present day surgical care we may at least expect to escape casualties in surgical attempts which in days, not so very long gone by, would almost certainly have resulted in the death of the patient. These average cases, however, do not constitute the usual source of our surgical mortality, consequently they do not interest us especially at this time. It is those cases which require not average but extraordinary care and precautions and judgment that we are now to consider; those cases which *may* die in spite of all we can do, which are almost *sure* to die if we err. Do we save as many of these people as we should? As we could? This is the field where the *real triumphs* of surgery are to be won, where the deepest gratification from success is to be obtained, and yet we often lose not only desparate cases but many which *seemed* to have at least a fair expectation of recovery. What is the reason?

In thinking these things over I have become persuaded that it is not in our actual operative procedures that we err most frequently. Indeed the trouble with most of us is that this particular part of the work obsesses us and in our enthusiasm for the operation and ITS details we do not allow proper weight to certain important fundamental considerations upon which success many times depends. With minds intent upon what from custom we have come to regard as *the* thing of importance we are apt to forget, for example, that every step of our surgical procedure is depressant to vital resistance; that every individual can endure but so much and no more; that in the last analysis no patient will live if the factors making for safety, which constitute the sum of his resisting powers, are outweighed by those opposing; and that in conserving vital resistance our safety lies. Now the operation *is* the most important thing, but nevertheless I am afraid we lose many of the cases which die because of non-attention to some accessory detail which, though perhaps not ordinarily regarded as of vital import, has proved of sufficient weight to turn a somewhat delicate balance and determine the question of death or recovery.

Some little thing such as a few lost minutes somewhere, a little too much undertaken; some neglected measure of precaution against the effects of trauma or shock or hemorrhage or exposure, an unwise selection of an anesthetic, submission to faulty operating room routine, has probably proved to be the last straw and worked our undoing.

To paraphrase the scriptural text concerning the three Christian graces, I should say that from the anesthetist's point of observation the three Surgical graces are Information, Preparation and Conservation, and the greatest of these is *Conservation.*

If asked to summarize the reasons for the majority of our unexpected surgical deaths I should say something like this:

We do not routinely use all the means at our command to ascertain the resisting power of the patient, and with something like a proper estimate of this in mind from the outset, adopt and adhere to a policy of management best calculated to conserve his natural resistance that it may be turned to account in effecting recovery.

If asked to be more specific I should say that some of our weakest points are these:

1. We do not sufficiently study individual vital resistance.
2. We make inadequate or obsolete provision against the onset of shock.
3. Our selection of an anesthetic is often made without due consideration of what its ultimate effects may be.
4. We are guilty at times of excessive traumatism.
5. We lose valuable time in our operating rooms because of non-essentials and unpreparedness.

While the great majority of our surgical cases are *average* cases and recover in spite of all these things

* Read during the Organization Meeting of the Interstate Association of Anesthetists, Cincinnati, O., May 4-5, 1915.

I would speak upon the foregoing points a little more in detail.

As upon the stage the *play's* the thing and the actor's technic comes second so upon our stage the *patient* is the thing and everything else follows after. Our first important duty is the study of the patient before operation with a view to determining not merely the nature and extent of the disease, but also, as nearly as possible, how far nature can be depended upon, with such assistance as we can give it, to take care of the consequences of surgical interference with her vital processes in the effort to cure disease. We do not always do this, but we should.

There is, unfortunately, no definite, sure criterion to guide us with certainty to a wise judgment in this respect. But while this is true, we have the lessons of experience, tongues to interrogate, eyes to observe and catch warning signals, physiological and pathological knowledge, laboratories and instruments of precision (including the blood-pressure apparatus and the kidney functional test), and the consistent use of these information gatherers will many times bring out revelations of conditions entirely unsuspected by the patient but which, if unknown to the surgeon, might lead to grave error. Hence we should omit no means of examination that promised any assistance in a comprehensive analysis of the case to the end that we may decide definitely if possible *what needs* to be done, how it may be done with least injury to the patient, whether the patient can endure that injury and recover, and then prepare for what is necessary so that there may be no indecision, hitch or delay from causes that could have been anticipated.

It seems superfluous to mention these things, but in surgery we are handling human lives, and we are now speaking of the factors entering into surgical mortality, and it must be admitted that in practice we sometimes operate upon persons whom we have never even seen before meeting them in the operating room. It would appear that as a measure of prudence and general protection, and as the just due of all our cases, we should work out and closely adhere to a careful scheme of procedure, before, during, and after operation for all cases alike, those presumably good and those obviously bad, modifying it only when circumstances demand. There is no denying that such a course taken routinely imposes a considerable burden upon us, involving much work and taking much time, but if it even *occasionally* leads to a discovery that would modify management in a single important detail then it should be held justified and necessary. On the other hand if we do *not* follow a routine we leave a disciplinary loophole through which error and failure and vain regret are sure to creep sooner or later.

SHOCK.

Approaching the operation the question of our defences against the factor of shock presents itself. In this shock, country land of malignant mystery, resides the evil genius of the surgeon, and there seems to be no road for the surgeon's patient to travel which must not penetrate its dread confines or at least cross its borders. The several theories as to the production of shock we will not attempt to discuss in this paper. It is with the prevention of shock that we are most concerned since this is more important than treatment. Skirmish or pitched battle. We *know* that we will have to combat this enemy and it is better policy to strike the first blow than to fight desperately in a ditch.

The experimental researches of Crile have convincingly demonstrated the serious physiological effects of psychic shock and have shown beyond question what actual cell damage great dread may accomplish. Many times have we seen the clinical effects of this in the stormy convalescence of a victim of extreme pre-operative fright. Traumatism is not the only influence which will exhaust the functional activity of the cell or even destroy it entirely. Now to prevent the occurrence of psychic shock we must begin before its cause begins to operate, and certainly this is as far back as the first announcement to the patient that an operation is desirable. Those individuals who are so phlegmatic and unafraid that this factor is negligible are very few. We are much more likely to meet with persons who, if they have reason to suspect that they will require an operation, will postpone what to them is an evil day and not consult a surgeon until absolutely driven by necessity for relief. Indeed, I doubt not that most of us, familiar as we are with the vicissitudes of surgery, would be staggered if we knew that we faced a major operation. And the reason is *fear*—fear of *death*. There can be no other emotion so disturbing. It shakes the average organism like an earthquake. Here, then, our treatment of shock should begin, and here is where we usually begin to make mistakes. We do not meet this condition seriously and *allay fear* and failing to do so we assume a handicap at the outset. With this in mind we must make it a point to reassure, and we must learn to do it in a way that will inspire courage, and confidence in the outcome. No effort should be spared to do this. It is worth while. Remove the fear of the anesthetic, which not a few dread more than the operation. The horror of complete unconsciousness and absolute helplessness

while something is being done that may cost life itself is a very real one to many people. Give the anesthetist an opportunity to win confidence and establish a desirable understanding, so that when he meets the frightened patient in the operating room he will mean something more to the patient than a total stranger who feels no personal interest and who says and does just what he would say and do in any other case. My experience leads me to believe that if we gave due attention to the patient's mental condition we would in some cases save life, in many cases save much suffering, in most cases save money as represented by hospital days and in all cases contribute much to our patient's comfort and satisfaction.

Traumatic shock arising during the course of the operation is one of the most important contributors to our surgical mortality, and will be spoken of as distinct from the depression of vitality due to such causes as a toxic anesthetic, or loss of blood, or overexertion from resistance, or mechanical interference with respiration, though certainly traumatism, in combination with all these things, tends to bring on the exhaustion which is the forerunner of collapse.

What operative procedures are most productive of traumatic shock? To begin with, a hacking skin incision rather than a clean, quick cut with a sharp scalpel. Then may follow a long list, such as crushing and dragging of nerves; handling and exposure of intestines; pulling on the mesentery; pressure on liver or spleen; traction on gall-bladder or uterus; dragging on stomach; squeezing of ovaries or testicles; roughness with retractors; massage of the patietal peritoneum with packing sponges—all these things produce shock. No one can be more alive to the fact than the watchful anesthetist. It is he who notes the falling blood-pressure, the quickening pulse and the increased rapidity of respiration, and it is he who is most keenly conscious of the fact that the condition progresses as time passes and the trauma continues.

How is it to be prevented, or held in check? Very largely I am sure by the *velvet hand* style of surgery and the development of a good technic in the use of a local anesthetic to block the sensory nerves in the field of operation. The entire operating corps should have in mind what manipulations are most productive of traumatic shock and be governed accordingly. Bloodgood and McKesson have urged the more general use of the blood-pressure apparatus as an indicator of shock. Unquestionably it is much more reliable than the best educated finger on the pulse can possibly be. Besides all concerned (not merely the anesthetist) would thus be constantly kept in closer touch with the state of affairs. But to the anesthetist, watching anxiously the progress of a critical case, the greatest surgery, (other qualities being anything like equal), is that which is distinguished by the greatest gentleness of touch and manipulation, and I am far from feeling sure that there is any other one quality in the surgeon of greater importance to the patient. The surgical signs of the times indicate that it will be a characteristic of the surgery of the future.

The question has often arisen as to whether pushing the anesthetic when unusual trauma is to be inflicted reduces the shock. Keen, in his work on surgery, remarks that many hold that in a critical operation when the patient is to be subjected to great shock, such as the things I have mentioned, the anesthetic should be pushed in order that the nervous system might be so obtunded that shock would not be felt. The logic of this is difficult to understand because we know that the action of ether is not such as to prevent the registration of impulses in the brain, certainly until we approach the lethal dose, although the patient may have been deprived of the power to signal resistance by its action on the cortex. So if we adopt this procedure we have only succeeded in adding to the shock the exhaustion produced by an overwhelming drugging. Furthermore this is what we have to pay for absolute relaxation obtained in the old way. Is it worth the price? Can we not secure it by less harmful means.

THE ANESTHETIC.

In recent years much progress has been made by wide experimental work in scientific anesthesia, by the more general development of capable anesthetists and by the creation of greater interest among surgeons. Further progress will come as the result of more general enlightenment on the subject of anesthetic pathology. There *is* such a thing as anesthetic pathology. We are coming to have much more respect for anesthesia than formerly, and especially are we apt to feel this respect working in us if we happen to have a notion that it may be necessary to submit ourselves to it. Nevertheless it is a fact that very many do not appear to *take in* the truth that instead of constituting a mere interim between two periods of consciousness it is a serious physiological condition involving cell changes carrying grave possibilities affecting the life and future health of the patient.

However, our present interest concerns the relation of anesthesia to surgical mortality. Simpson

(1), in this connection, recently expressed himself as follows:

"Probably one third of our deaths could be attributed to the disturbing effect of the anesthetic on metabolism, i. e., its influence on the liver and kidneys. The more we know of acetone bodies and the effect of metabolic disturbance the more do I believe that the anesthetic and its effects on metabolism will probably be found to cause a high percentage of the deaths that occur."

The old time conception of an anesthetic death is that of one occurring practically on the table, though the anesthetic may be, and often is entirely guiltless, such an unfortunate occurrence being no more necessarily due to the anesthetic than whatever may come later is surely a consequence of the operation. Now a death occurring as the result of disturbed metabolism by anesthesia would only come as a more or less remote *after effect,* and would probably be erroneously attributed to something other than the anesthetic. *But* if anesthesia is by any possibility responsible for *anything like* 33 per cent. of our surgical deaths it becomes a vastly different proposition from the idea many of us have held regarding it and from what our statistics would lead us to believe. If the anesthetic substances we have been in the habit of using are capable of bringing about changes which kill one third of the cases we lose then it is high time we became alive to the fact and look about for something less harmful and fatal. The general anesthetic most commonly used to day is ether, and the question comes squarely before us: *Is there any good reason to believe that ether can produce such serious effects as to be responsible for so many so-called surgical deaths?*

What do we know about ether? That it is believed to produce anesthesia by a chemical solution of the lipoid substances of the brain cells. Incidentally it also attacks other lipoids with which it is brought into contact—the lecethin of the red blood cells causing a temporary anemia, the lipoids of the white blood cells thereby disturbing phagocytosis and thus lowering resistance to acute infection, also the specialized fats of the liver, kidneys and other organs, thus interfering with normal metabolism and elimination. The action of ether on these fats has been shown experimentally.

An evidence of disturbed metabolism is the great frequency of post etherization acetonuria. How many of us routinely take precautions to guard against acute acetonemia? But what surgeon of large experience has not lost cases or at least had to deal with severe symptoms of acid intoxication following operation? In view of the chemical derivation of acetone bodies their presence is probably an expression of abnormal fat destruction, and the frequency of acetonuria following etherization considered in connection with the theory of lipoid solution by ether suggests more than a coincidence. The literature on the subject is extensive. Dr. Lewis Beesley, after two years investigation chiefly at the Royal Hospital for Sick Children, Edinburg, concluded among other things that *"both ether and chloroform invariably produce a temporary acute acetonemia. Acute acetonemia is accompanied by symptoms of acid intoxication, sometimes ending in death when the kidneys are unable to cope with the increased formation of acetone; a guarded prognosis must always be given when acute acetonemia is present with symptoms of poisoning."* It would be interesting to analyze the literature on this subject more completely and show its frequency and seriousness, but we are trying to cover too much ground in a short time. The whole trend of it, however, tends to confirm the writer quoted. The presence of acetonuria means disturbance of metabolism, especially in the liver. The pathology is some degree of fatty degeneration of the liver, kidneys and muscles.

The relation between anesthesia and shock has not been definitely determined, but that certain anesthetics do increase the effects of shock by their depressing toxicity there can be no manner of doubt. One of Crile's experiments, comparing ether with nitrous oxide-oxygen in the effort to determine this factor is interesting. Ten dogs were taken in each of two groups. The first ten were given ether by the drop method and shock produced by rubbing the peritoneum for three hours. The second group were given N_2O with O and shock produced in the same manner. Blood pressure tracings were taken to determine the reaction. The ether dogs at the end of three hours showed an average pressure of 10 mm. of Hg., whereas the N_2O dogs showed 110 mm. of Hg. The difference is certainly striking, be the explanation what it may.

Now let us make the application to our subject of surgical mortality which we have conceded is almost entirely confined to those cases which are handicapped in some particular. If, in dealing with these persons, we use for anesthesia a substance which will cause anemia, lower resistance to infection, produce more or less grave metabolic disturbance and in all probability add much to the effects of surgical shock, why then possibly Simpson may not be far wrong when he says that a third of our surgical deaths may be attributed to the anesthetic without injustice. Certainly a little earnest study of the effects of anesthetics, both immedi-

ate and remote, increases our respect for the possibilities of ether, cautions us to be careful of its selection and use especially in patients with a low grade of resistance, warns us against its early repetition in any case, and suggests an explanation of postetherization symptoms which have not been any too well understood.

The alternative to ether as a general anesthetic is N_2O with O. I am aware of no authority on the subject who does not admit that this combination involves less danger to the patient than any other we have at our command. From the patient's standpoint it is as nearly perfect an anesthetic as we can well expect to obtain. Most of us know something about it from experience. It is believed to act solely by interference with the use of oxygen by the brain cells. No one has been able to show any material detrimental effect upon the organs of the body, and we are all aware how quickly it is eliminated. Logically, therefore, if it *can* be used it *should* be, because of its freedom from all those influences which go so far to determine mortality. Certainly it should be used when the odds are against recovery, though to confine its use to this class of cases seems hardly fair to the anesthetic. Its danger is a matter of technic in administration and can be controlled. On the other hand the after effects of ether once it is given, like a word once spoken, are beyond our power for good or evil. As has been well said there is no fool-proof anesthetic. The principle objection to the routine use of gas and oxygen lies in the fact that even when preceded by morphin complete relaxation may not always be possible, and sufficient relaxation is a requisite in abdominal work. Crile and others have demonstrated the practicability of gas in a large majority of abdominal cases, however, and Crile's mortality report of 0.8 per cent. in a thousand miscellaneous cases is a pretty low record.

There is this to say, however, in regard to gas and oxygen—if we expect to use it in abdominal surgery without disappointment except in selected cases of low vitality or with flabby abdomens, if we are going to give our patients generally the benefit of the anesthetic which is least harmful to them, it will be necessary for the surgeon and the anesthetist to get together, develop a technic similar to Crile's, and with a mutual understanding of the needs of the situation and the possibilities of the anesthetic, harmoniously cooperate with each other in the interest of the patient. By so doing most cases, whatever the operation, could be given the benefit of this excellent anesthetic. In those cases where ether was necessary it could be used in minimum quantities and discontinued when the exigencies of the case permit. Team work is always important, though we must admit that we don't always have it. But it is especially important when the anesthetic is gas and oxygen. Many anesthetic difficulties, even when using ether, are due to unexpected (hence unprepared for) manipulations, and are most apt to occur when the anesthetist is carefully nursing a case along with as little of the drug as possible. The trouble with us is we do not properly appreciate the advantages of gas to the patient, ether is so much easier to use and we have the ether habit. Perhaps we are influenced by a desire to save him a few dollars for the increased cost of the gas, letting him endure the difference in discomfort, take his chances as to other complications from ether, and if he has to pay for more hospital days why we can't help that.

In conclusion a few words on the relation existing between the patient's power of endurance and the factor of *time*, time selected for, and time consumed in operation, as it bears on surgical mortality. In such conditions as acute appendicitis, intestinal obstruction or perforation, the time relief if attempted with relation to onset may decide the question of success. Here there is an opportune moment which if allowed to pass unimproved multiplies many times the chances against recovery. This critical moment may have been allowed to pass through no fault of ours, sometimes this happens through our own bad judgment. Again, in other cases, where the question of lack of resistance is a serious one, by doing a single severe operation in two stages (which is sometimes practicable), or by declining to combine two operations in one, thus dividing the forces of the enemy, so to speak, we may display good generalship. As for time consumed in various ways during operation, who is there among us who has not seen numbers of cases hold up well through a fairly long period and go to pieces in the last few minutes of the operation. Now there are many ways in which these few vital minutes may have been *thrown away* which readily occur to us after the mischief is done, just as there are ways of conserving time and the patient's vitality which also occur to us, but which, we must admit we do not always practice. In consequence cases which have no vitality to throw away may be lost and we scarcely appreciate the reason for it. Time is a factor which tells mightily when a person is approaching the limit of his resisting power. Our operating room habits and customs and methods should be revised and refined with no lost motions and no lost minutes as the objects to

be attained, because we face situations in the operating room time and time again when lost motions and lost minutes mean lost lives as we all know well enough.

The individual who studies the causes of surgical mortality largely from the viewpoint of the anesthetist, who keeps in touch with the very important work being done along the line of physiological and pathological effects of different anesthetics, who has observed closely and thoughtfully in all sorts of patients the contest of the vital forces against the combination of disease, surgical trauma and anesthetic drugs, who has watched the rally and retreat and often noted with anxiety what seemed to be the final turning point down grade, may perhaps acquire a bias of judgment and come to interpret many surgical fatalities from the standpoint of the anesthetist alone, but certainly he cannot escape the conviction that we would approach much nearer to the attainment of all that is possible in our results if, while striving to perfect our operating technic, the necessity for more attention to the minor points, the side issues (so called), were also kept in mind. Rifle bullets kill more soldiers than twelve inch projectiles.

Genius has been said to consist in an infinite capacity for little things. I believe it was Angelo who said, while working painstakingly on the big toe of his statue of Moses—"Trifles make up perfection, but perfection is no trifle."

1229 O. Street, N. W.

ETHYL CHLORID ANESTHESIA.*

RAY A. RICE, M.D.,
Chief Anesthetist to Grant Hospital.
COLUMBUS, OHIO.

The subject allotted to me is one in which I am very greatly interested, yet one which few anesthetists, comparatively, know very much about. Hence the history of this drug, which I consider one of the most useful of all the agents used for anesthetic purposes, should be of great interest to physicians and dentists who make anesthesia a special study.

Ethyl chlorid (sweet spirit of salt) was first obtained in alcoholic solution by Basil Valentine; Flauber referred to it in 1648. In 1749 Ludolff stated that, on heating alcohol with sulphuric acid and sodium chlorid, a distilate was obtained which, when treated with lime, yielded an ether, but he endeavored in vain to obtain a similar compound by the action of hydrogen chlorid on alcohol. Woulfe obtained the preparation in this way and it was afterwards prepared and sold by an apothecary in Germany under the name of Basse's hydrochloric ether. This was in 1801.

Flourens drew attention to the anesthetic properties of ethyl chlorid in 1847, and Heyfelder in the following year first administered the vapor of this substance for a surgical operation. Although his administrations were quite successful, it was not until the year 1896 that ethyl chlorid became a recognized anesthetic. Unsatisfactory symptoms often accompanied its administration, previous to 1895. These effects were attributed to imperfection in its manufacture and the consequent presence of impurities. Since 1895 it has rapidly gained in favor, attributable to the improved methods of administration and to an increase in knowledge of its properties and physiological action, and to improvement in its manufacture. It may be regarded as ethyl alcohol ($C.H._3$ $C.H._2$ O.H.) in which the O.H. is replaced by C.L.

Ethyl alcohol is the raw product from which it is usually made. Ethyl chlorid is the result of treating acetic and other ethers with hydrogen chlorid. In actual practice, ethyl alcohol is mixed with hydrogen chlorid, which acts as a dessicating agent. Impurities may be found, yet if pure hydrogen chlorid be used there is little danger from this source. The quality of alcohol used is of great importance. The report, after an examination of seven different makes of ethyl chlorid, states that it should be free from water, foreign chlorids, acids, aldehyds, ether, alcohol and organo-metallic substances. It is, however, purified by passing the vapor through water, dilute caustic solution, and then concentrated sulphuric acid. This treatment is intended to free it from alcohol, hydrogen chlorid and water.

It is a colorless mobile liquid and is exceedingly volatile. It possesses a sweetish taste, and a pungent, yet fragrant "ethereal" odor. It is inflammable, burning, when ignited, with a smoky green edged flame, producing fumes of hydrogen chlorid; hence care must be exercised in using it near an open flame or a hot cautery. It even decomposes when near a hot bulb or electric light. It does not freeze at 29 degrees C.; it possesses a boiling point of +12.6 degrees C. Owing to its extreme volatility, it cannot be kept in ordinary bottles, except at a temperature below +10 degrees C., and then it must be exceptionally well stoppered. It is furnished to the market in sealed tubes filled under considerable pressure.

In many instances, uncertain results have been

*Read during the Organization Meeting of the Interstate Association of Anesthetists, Cincinnati, May 4-5, 1915.

encountered by those using ethyl chlorid for general anesthesia and these have been attributed in some cases to impurities that were present and were later detected chemically. In such cases the original product must have been improperly purified, for the conditions essential for the decomposition of ethyl chlorid involve oxygen, and there is no way for oxygen to enter the tube after it is ready to dispense. The detection of impurities in ethyl chlorid presents many difficulties which are not encountered in the examination of ethyl ether or chloroform, and as Gwathmey states, it is indeed quite fortunate that it can be prepared with such a degree of purity.

ITS EFFECTS UPON THE RESPIRATORY, CIRCULATORY AND NERVOUS SYSTEMS.

According to Muller, the effect of this drug on the lungs is pathological, rather than physiological. Ethyl chlorid has been used very extensively by some anesthetists, especially in short operations, and as a preliminary to ether and chloroform anesthesias in longer operations, and it is found that it rapidly produces general anesthesia. In some cases respirations cease and in others convulsive movements supervene. According to Hewitt, Kemp found stertor, difficult respiration, tremors and convulsive movements of the legs.

In my own experience, which has been quite extensive, I find with pure ethyl chlorid for general anesthesias there is no strangling sensation, excepting in very nervous patients. The respirations are not labored at first, the heart action is quickened. After a few inspirations the respirations quicken, showing the patient is passing into the first stage of anesthesia; the muscles become rigid and in some cases are in a state of tonic or may be clonic spasm. This condition may interfere materially with respiration, causing it to become quite labored and in many instances to cease. Under such conditions we have cyanosis and what resembles a paralysis of the respiratory center. If the administrator continues the drug, or is unusually slow in re-establishing a patent respiratory passage, there will be brought on a paralysis of the respiratory center, a weakening of the heart action and a condition resembling death, if not death itself.

Koenig found that the rapidity of narcosis depended on the degree of dilution with air. A mixture of 10 per cent. ethyl chlorid vapor with 90 per cent. air caused narcosis in small animals at the end of six or seven minutes; 50 per cent. mixtures rapidly caused narcosis lasting for some minutes. Pure ethyl chlorid vapor caused regular and rapid lowering of arterial pressure ending in respiratory and cardiac arrest. W. Webster found small doses of ethyl chlorid caused augmentation of the respiratory movements and lowering of the blood pressure during narcosis. The heart beat was at first decreased and then increased. With large doses the breathing ceased some time before the heart stopped.

All authorities agree that ethyl chlorid is taken up by the blood with great rapidity, that it is eliminated rapidly, and that under surgical narcosis a very great fall in blood pressure is noted.

Embley says the effect of ethyl chlorid on the heart muscle is paralytic. He further states that the effect on the arterioles isolated from the central nervous system, is relaxation. Both the above effects are similar to those from choloroform, only it takes about 19 times as much ethyl chlorid to produce the same results. Embley also found that the action of ethyl chlorid on the vascular system caused dilatation. This theory coincides with that of Buxton, who claims ethyl chlorid causes a flushing of the face, due to dilatation of the peripheral vessels, which accounts for the fall of blood pressure accompanying ethyl chlorid anesthesia.

The circulatory changes are always secondary to the respiratory. The effect of ethyl chlorid on the nervous system is not so important, as only a small amount of this drug enters the cerebrum and ganglionic cells, because it is so slightly soluble in the cell juice, hence insufficient to produce paralysis of the cells.

EFFECTS ON MUSCULATURE.

Although the centers of pain sensation may be paralyzed, the quantities do not always suffice to paralyze the more resistance centers. As a result the reflexes and the muscles are not completely paralyzed, inhibited or relaxed in the anesthesia. The muscular system seems to be about the most stubborn. Muscular rigidity is always present in the stage of excitement. In some cases, according to Hewitt, muscular relaxation accompanies stertor, but there is more often rigidity. This rigidity in some subjects may be so great as to culminate in opisthotonos. The great tendency to contraction of the masseter muscles has been noticed, so much so at times to be really dangerous, causing an obstruction of the respiratory tract. I have found it in many cases necessary to place a mouth gag or a block between the teeth before beginning the anesthesia. I have also experienced the opisthotonos state several times in the beginning of the anesthesia. The effects of this agent upon the glandular system are a diminution of the secretions of the kidneys and liver. The gastric and intestinal functions seem to be only slightly influenced.

From the experimental work of the physiologists and practical experience, we must agree with Hewin that ethyl chlorid may prove fatal in two ways, (1) by simple overdose, ethyl chlorid toxemia or syncope; and (2) by intercurrent respiratory embarrassment (asphyxia).

With the first cause we have pallor, pulselessness, arrest of breathing, wide dilatation of the pupils, general muscular flaccidity and separation of the lids, and cardiac arrest.

According to Hewitt, in death from asphyxia, the embarrassed respiration may depress a heart already weak from the drug itself. Prominent symptoms of this death are spasms about the jaws, mouth, tongue, larynx, or respiratory muscles. There is an arrest of breathing with some cyanosis, followed by cardiac arrest.

The Stages of Ethyl Chlorid Anesthesia.

Concerning the different stages of ethyl chlorid anesthesia, we may say that it differs little from any other pulmonary anesthetic. The first stage of course is the analgesic state coming on after very few breaths, and is of very short duration. Following at once is the stage of stertor and considerable spasmodic action of most the entire muscular system. The jaws are set and in many robust subjects there appears at this time tonic or clonic convulsions of the muscular system in general. There is one drug that comes nearer to a specific for this condition than any other yet found in my experience; this, however, will be discussed later.

Gwathmey, in his description of the second stage, mentions the fact that we not only find true anesthesia, but that after the mask is removed from the face anesthesia is deepened owing to the absorption of the ethyl chlorid from the lower air passages. This may be true to a certain extent, but a practical view as to the cause of this deepened anesthetic state is that oxygen has been allowed to enter the lungs by raising the mask or by forcing oxygen into the inhaler at the time of an inspiration.

The third stage is again one of analgesia as is the first.

The fourth, when administration has been carried too far and there is complete cessation of respiration, arrest of the heart and death.

The first stage lasts from one-half to one minute; abscesses may be opened at this time.

In the second stage, which lasts from one to three or four minutes, any minor operation may be performed. The anesthetic may be safely continued in this stage for a considerable length of time, if administered by one familiar with the amount and the symptoms that may at any moment appear. I think the longest time I have carried a patient in this second stage has been one-half hour; many times from 10 to 15 minutes.

In the third stage, lasting about the same length as the first, there seems to be no sensation to pain, yet the patient may talk.

In prolonged ethyl chlorid narcosis, Muller recognizes four stages. The first and second he claims are very brief, which is of course true, providing the anesthetic is stopped when the second stage is reached, but in my opinion prolonged anesthesias are carried entirely in the second stage if the anesthesia is a perfect one; of course, under such conditions neither the third stage should be allowed by raising the mask nor should the fourth stage by any means be allowed to supervene by carrying the anesthesia to the stage of paralysis of the respiratory center followed by cardiac arrest. I like the classification of Herrenknecht (as quoted by Gwathmey), which is the following: (1) The prenarcotic analgesic state. (2) The stage of excitement. (3) The stage of deep sleep. (4) The post narcotic analgesic state. His classification is found in anesthesias given as they should be, not in those given as they frequently are. My experience coincides nearly identically with that of Herrenknecht.

The third stage of my anesthesias with ethyl chlorid, a continuation of the second stage of Gwathmey's classification, is that of deep sleep, especially since I have adopted the routine plan of giving oxygen with this agent. I think oxygen has made ethyl chlorid anesthesias less toxic and I seldom have any stage of excitement or spasmodic muscular contractions since adopting this method. I do not use the oxygen, however, when using ethyl chlorid as a preliminary to ether or chloroform, which by the way is my method in all such anesthesias. The signs of an overdose are (1) very widely dilated and fixed pupils, eyelids open; (2) great pallor; (3) intermittent respirations or gasping for breath.

Ethyl chlorid, from observations made by different men, is not eliminated in the undecomposed state, the chlorin, at least, disappearing from the expired air. At any rate, according to Lotheissen, ethyl chlorid does not remain fixed for any length of time, so that it cannot exert any prolonged narcotizing effect, which is a great advantage when asphyxia threatens.

Elimination takes place mostly from the lungs; in fact, almost entirely so in brief anesthesias, because so little is absorbed by the blood. Kidneys

and other excretory organs enter into the elimination in prolonged operations. The after effects are not of much consequence. There seems to be no albumin in the urine. Ethyl chlorid exerts no injurious action upon the blood corpuscles and the kidneys. Clinically the after effects depend upon the preparation of the patient, the length of the administration and the method employed.

There is more or less vomiting in a great per cent. of cases, which does not, however, last long, and is associated with considerable headache. Erotic sensations are more liable to occur with ethyl chlorid than with other anesthetic agents, excepting nitrous oxid.

Collapse seems to be very liable to follow this anesthetic, more so, I think, than any other.

COMPARISON OF ETHYL CHLORID WITH OTHER ANESTHETIC AGENTS.

The narcotic power is similar to that of ether, but weaker than chloroform. Because of its rapidity in destroying consciousness and its evanescent effect it is very similar to nitrous oxid. Maass, who is an opponent of ethyl chlorid narcosis, maintains that in regard to danger it is at least equal to chloroform. I most certainly agree with him as regards to the use of ethyl chlorid for an anesthesia of any length, or one requiring any special degree of relaxation, and especially if administered by one not accustomed to its varying effects.

Anesthetists who refer to the use of chloroform as a preliminary to ether are evidently ignorant of the great value of ethyl chlorid as such preliminary. There is no comparison of the two agents in my estimation. The greatest danger in the use of chloroform is in the first and second stages of anesthesia, when the patient is breathing rapidly and in a state, usually, of excitement.

Maass condemns ethyl chlorid as a preliminary to chloroform and goes still further and claims it is an added danger in the beginning of ether narcosis; hence it is evident that Maass is considerably prejudiced or else is not fully acquainted with the advantages of this agent.

Ethyl chlorid is a very valuable anesthetic or analgesic in parturition, because usually at the time when forceps are applied, the patient is in a state of more or less exhaustion, hence a small amount of anesthetic is required. On the battlefield ethyl chlorid is specially indicated, because soldiers awaken sooner and more completely from this agent than from ether or chloroform, and it causes less shock to the wounded.

The advantages of ethyl chlorid over other liquid inhalation anesthetics are the rapidity with which it produces anesthesia and usually the absence of after effects. We all know ethyl chlorid can never replace chloroform or ether where loss of sensation is required for a prolonged period. My experience with ethyl chlorid coincides with that of Herrenknecht, who concludes it is the least dangerous narcotic which we possess at present, not excepting nitrous oxid. This statement of course applies to anesthesias of short duration.

The inhalation should always be interrupted with the disappearance of reflexes and the onset of muscular relaxation. When any dangerous symptoms appear they are with the respiratory apparatus rather than the circulatory.

Hewitt thinks it is far more dangerous than nitrous oxid and distinctly more so than ether, his reason being the pronounced fall of blood pressure which takes place. Boyle says it cannot be compared to nitrous oxid and oxygen, and rates its dangers as equal to those of chloroform. Luke and Ross state it is safer as an anesthetic agent than ether, chloroform, or ethyl bromid, but not as safe as nitrous oxid. Behr indicates as special advantages of ethyl chlorid the relative harmlessness of the drug when used in suitable cases; its pleasant odor, the absence in most cases of excitement, the rapid induction of the anesthesia, the speedy return to consciousness and practically a total absence of after effects. Children, according to all the authorities, are the best subjects for the administration of ethyl chlorid. I have never used ethyl chlorid as an anesthetic in very young children except as a preliminary, yet it is claimed by some authorities to be a good anesthetic in children as young as a few days, being especially well borne by infants from a few weeks to a few months old, up to about eight years. They take it quietly and without difficulty, losing consciousness in 10 to 30 seconds. It gives a very satisfactory anesthesia lasting from one to one and a half minutes. I have used it frequently in adenoid and tonsil operations, but prefer to follow with a little ether.

I realize that in cases where there is much edema or swelling about the neck it must be given with great care and as little in amount as possible. My principal injunction, I wish to emphasize, is that ethyl chlorid is more satisfactorily given with a continuous flow of pure oxygen. Lotheissen has proposed an improvement in ethyl chlorid narcosis by a simultaneous inhalation of pure oxygen and ethyl chlorid. I have been using this combination with extreme satisfaction for over a year. Previous to this time I used straight ethyl chlorid and because of the fact that many of my patients, after

a few inhalations, developed a tonic and clonic spasmodic action of the muscular system and in some instances bordered on to opisthotonos, I began to think of some method to eliminate these disagreeable symptoms. Knowing the power of oxygen to eliminate the spasmodic action of ether from anoxemia, and that chloroform was less toxic when given with it, I tried the oxygen and ethyl chlorid sequence, which has, to my great satisfaction, made this form of narcosis a very efficient one. The apparatus used is my own ether inhaler, which has an oxygen attachment on one side, to which the tube from a low pressure tank is attached.

In closing I will mention a few facts:

(1) Surgical anesthesia is established, according to Gwathmey, in about eight minutes. In my own experience this time is reduced to possibly two minutes or less.

(2) The stage of excitement, if any, is of very short duration.

(3) Complete anesthesia, having been gradually induced, the pulse is full and slow and respiration regular, not stertorous. In my experience I find the pulse full but considerably quickened, and the respirations rapid and frequently stertorous. When used in sequence with ether, the pulse becomes quiet when ether is commenced.

(4) In no instance has there been an increase in saliva or bronchial mucus during narcosis.

(5) The face presents a healthy color, no pallor or cyanosis.

(6) If too little of the anesthetic is given, the patient will gag or vomit; if too much is given, respiration will become shallow, and eventually, if more is given, will stop altogether, but the pulse is not interfered with; in other words, as I have said before, the respiratory, and not the circulatory, center is affected first by an overdose. The tendency, all through the narcosis, is to recovery rather than profound anesthesia.

(7) After the anesthetic has been stopped, the patient soon comes to, frequently while yet on the table; if he sleeps longer, it is usually from a preliminary of morphin and scopolamin.

(8) Vomiting, slight, occurs in a small percentage of cases after recovery. It is not, however, prolonged or of a distressing type.

(9) After effects, as bronchitis, pneumonia, or nephritis, are not seen.

(10) Patients having serious valvular cardiac lesions, chronic pulmonary affections, diabetes, profound anemia or other complications, stand this anesthetic well.

(11) The quantity used is generally small.

1520 MENLO PLACE.

DISCUSSION.

DR. MARTIN M. WARE, New York City: In discussing Dr. Rice's paper, I hope I will be pardoned for referring to my personal experience by way of rounding out his admirable exposition of ethyl chlorid anesthesia. As a pioneer in the use of ethyl chlorid for general anesthesia I experienced many of the rebuffs which the originators of newer methods have always had to contend with and in addition the prejudices in favor of the more strongly entrenched anesthetics, such as chloroform, ether and nitrous oxid, with their endorsement of prolonged usage. The mortality rate of ethyl chlorid became the vital issue in its acceptance as a routine method of anesthesia. Personally I have been able to review 15,000 administrations without fatality. While deaths from its use have been reported, the causative factor, upon thorough examination of the reported cases, has invariably been found to have been something else than the anesthetic. What few deaths have occurred have been associated with grave pathological conditions which rendered the persons operated extremely hazardous risks.

Dr. Rice emphasizes the occurrence of respiratory paralysis after prolonged administration. I should rather say after excessive dosage. Ethyl chlorid, like all other anesthetics, kills by respiratory paralysis, if its administration is pushed far enough.

Ethyl chlorid, during its administration, requires a liberal admixture of air, or as Dr. Rice suggests, oxygen. The control of the plane of narcosis by mechanical devices is to be deplored, as the safe and successful administration of ethyl chlorid requires the exercise of gray matter.

While there is an excitement period with ethyl chlorid if administered without sufficient air or oxygen, and tonic or clonic spasms of the musculature may result, I maintain that these untoward occurrences are less frequent under ethyl chlorid than nitrous oxid. A trismus of the masseter muscles, connected with disease of the last molars, will yield to ethyl chlorid when it will not relax from nitrous oxid.

I know of no anesthetic agent from which the patient, narcotized to the fullest degree, will so promptly awaken and fully recover in so brief a time.

While ethyl chlorid is not especially advantageous for prolonged administrations, it is the ideal anesthetic for brief narcosis and for anesthesia in emergency surgery.

It need scarcely be reiterated that a pure product must be used.

The concomitant use of oxygen offers possibilities of developing a satisfactory and accurate method for its prolonged administration, that may prove sufficiently inexpensive not to be prohibitive.

TO THE READERS OF THE SUPPLEMENT.

Forthcoming issues of the Supplement will contain contributions from the following notable authorities in anesthesia and analgesia:

W. D. Gatch, C. W. Moots, G. W. Crile, F. C. Mann, A. H. Miller, F. Wayne Babcock, Jos. C. Bloodgood, F. G. DuBose, D. E. Jackson, Truman Brophy, Kurt Thoma, Rich. H. Reithmüller, Jos. E. Lumbard, Evarts Graham, Moses Salzer, Ira O. Denman, Hugh W. MacMillan and N. T. Yager.

SOME BASIC PRINCIPLES OF GENERAL ANESTHESIA.*

CARL G. PARSONS, M.D.,
Fellow of the American Association of Anesthetists and Lecturer on Anesthetics, University of Denver, Dental Department.
DENVER, COLO.

There are certain basic principles of anesthesia which we, as anesthetists, should have firmly fixed in mind, not only to insure our own clinical success, but more especially to safeguard the welfare of our patients. I have tabulated these basic principles of anesthesia previously (*Denver Medical Times*, July, 1911), but they are now presented in detail and are as follows:

1. The gradual administration of anesthesia with continuous, equal drug-distribution.
2. Percentage limitation of vapor concentration.
3. Maintenance of a patent airway to prevent embarrassment of respiration or circulation.
4. Differentiation of pupil reflexes.
5. Routine method of resuscitation in emergencies.

THE GRADUAL ADMINISTRATION OF ANESTHESIA, WITH CONTINUOUS, EQUAL DRUG-DISTRIBUTION.

The induction of anesthesia with undue haste is dangerous to the patient. When an anesthetic agent is inhaled there takes place in the nerve cells and centers certain physico-chemical changes, which cause cellular disarrangement. Now, if the induction of anesthesia be too rapid, these structures are overwhelmed, and if sudden death does not occur, various disagreeable symptoms may present.

Speaking of chloroform, Hewitt says that: "In a large proportion of accidents, overdosage, in the usual sense of the term, is conspicuously absent."

Of course, he here refers to the deaths which are seen early in anesthetization, either from a too rapid administration or from reflex inhibitory phenomena, and other conditions which are noted later.

I know of no better way to present this important principle than to quote partly from an article which I once wrote, entitled "The Law of Anesthetic Accommodation":

"During the induction of anesthesia, if the administration is conducted gradually and uniformly, the following results obtain:

"The anesthetic is safer. Syncopal attacks are minimized, especially when using chloroform, as the vapor is not concentrated; the patient is able to breathe during the first stage without a feeling of irritation or suffocation, which may lead to choking or vomiting; in reality, quicker time is made in getting a patient to the third or surgical stage than when the anesthetic is crowded. The second stage of excitement is absent except, perhaps, in very muscular and alcoholic subjects; it does away with the asphyxial element of ether; the administrator has his patient under better control, *i.e.*, he is better able to know his subjects' narcotic susceptibility. There is a uniform anesthesia; there is no appreciable fluctuation in the percentage of vapor inhaled; but a gradual, scientific anesthetic state brought about which permits of a deeper and more satisfactory narcosis with a small amount of drug being used."

PERCENTAGE LIMITATION OF VAPOR CONCENTRATION

An overdose of anesthetic is a concentrated dose. Anesthetics, volatile, hypervolatile, or gaseous in nature, cause many disagreeable and dangerous conditions when given in undue concentration. We may cite only a few instances, viz.: Chloroform will cause death almost at once from its toxic and depressant action on the medulla and heart. Ether will cause spasm and obstruction of the upper air passages with consequent cyanosis and may thus lead to death.

Ethyl chlorid (including somnoform) will produce a spasmodic condition of the respiratory muscles, and also clonic and tonic spasms of various muscles of the entire body with unsatisfactory anesthesia.

Nitrous-oxid in undue concentration will soon produce jactitation.

Safe and satisfactory anesthesia obtains when the inhalation process is uniform and the correct percentage of vapor or gas for a given patient is used. A drop-ether open method may contain a vapor percentage within the dome of the mask anywhere from no per cent. up to the point of saturation. The amount of concentration (in other words, dosage, or percentage) of various anesthetics for man is fairly well established—ether, for example, being about 15 per cent. by weight when the patient is surgically anesthetized.

MAINTENANCE OF A PATENT AIRWAY TO PREVENT EMBARRASSMENT OF RESPIRATION OR CIRCULATION.

A normal individual has a certain relative tempo of both the respiration and heart beat. On an average there are four pulse beats with every respiration, 4.72. Any interference with free respiration will produce abnormal changes in the heart and circulation. Respiratory pressure has a marked influence on the dilatation and contraction of the heart.

* Read during the Third Annual Meeting of the American Association of Anesthetists, June 21, 1916, at San Francisco.

Cardiac dilatation during disatole is partly produced by the elastic traction of the lungs during inspiration—the greater the inspiration, the greater the expansion of the heart. The opposite occurs in expiration, there being compression with but little blood entering the heart. If the glottis or upper air passages are obstructed during anesthesia, the heart action suffers directly in proportion to the obstruction, and the systemic and pulmonary circulations are in turn affected. The toxic action of an anesthetic will produce serious trouble if the distribution and elimination of the drug is not carried on properly.

In sluggish or arrested circulation, the anesthetic exerts its toxic influence on the heart, that is, the endocardium, coronary circulation, and ganglia, and also on the sinus of the venae cavae (Remark's ganglia), and medulla. When the thorax is not under any strain, and is in a position of moderate rest and normal elastic traction (7.5 m.m. Hg.), the conditions for the action are most favorable. Not only do the lungs, but also the heart and circulation, feel the effects of pressure changes produced by respiratory obstructions.

The thing to do, therefore, during anesthetization is very simple—maintain the very best unobstructed airway possible.

DIFFERENTIATION OF PUPIL REFLEXES

The following table gives the differential diagnosis between physiological reflex dilatation and pathological paralytic dilatation of the pupils during anesthesia:

REFLEX DILATATION.	PARALYTIC DILATATION.
Pupil is bright, mobile, liquid, life-like hue.	Pupil is dull, sluggish, immobile, death-like condition.
Other reflexes usually present.	No reflexes of any sort present.
Patient shows signs of "coming out."	Entire body relaxed.
Marginal motility of the iris is present.	No marginal motility is present.
Eye-balls may roll.	Eye-balls are fixed.
Reaction of pupil to light.	No reaction of pupil to light.
Not enough anesthetic has been given, determined by clinical experience.	Too much anesthetic has been given, or not enough, resulting in reflex, cardiac inhibition.
Respiration and circulation in fair condition.	Respiration and circulation failing.
Skin has good color.	Skin is cold and clammy; pallor or lividity.
Eyelids usually closed.	Eyelids remain partly open, due to relaxation.
Tonicity of eyelids is present.	No tonicity of eyelids.
Tears are not markedly secreted.	Increased secretion of tears.
More anesthetic will contract the pupil (third stage).	More anesthetic will produce still wider dilatation, plus respiratory and cardiac arrest.
Less anesthetic will cause pupil to remain large (reflex dilatation).	Less anesthetic, or none, will cause the pupil to contract back to third stage.

ROUTINE METHODS OF RESUSCITATION IN EMERGENCIES.

1. Remove the mask.
2. Get the tongue forward.
3. Lower the head.
4. Artificial respiration.
5. Dilate the sphincter.
6. Drugs.

These are practically self-explanatory, but one or two points should be emphasized.

The mask is removed to prevent more vapor from being inhaled during artificial respiration. Strange as it may appear, I have seen internes producing Sylvesterism with a saturated mask left on the patient's face!

The tongue is brought forward to obtain a free airway.

The head is lowered to send blood to the vital centers in the brain; except perhaps in cases of deep cyanosis.

Artificial respiration is given to produce aeration of the blood, to keep or set in motion the heart by indirect stimulation, and to eliminate the anesthetic from the system.

Dilating the sphincter produces the well-known ano-respiratory reflex, but should not be relied on wholly, because in a certain percentage of cases there is no reflex set up by the method. It often sets the respiratory pump in action, and should always be used in conjunction with other means of resuscitation.

Drugs are purposely placed last on the list, because their action is not rapid enough to give quick results by themselves. When a patient has entered the fourth stage of anesthesia, mechanical measures of resuscitation should always be used first, and later whatever drugs seems desirable can be selected and given.

228 METROPOLITAN BLDG.

TO THE READERS OF THE SUPPLEMENT.

¶ Forthcoming issues of the Supplement will contain the papers read during the Special Section of Anesthesia of the Joint Session of the National Dental Association and the Interstate Association of Anesthetists. This will be one of the most authoritative symposiums on Anesthesia for Oral Surgery ever published.——*Editor.*

FACTORS OTHER THAN THE ANESTHETIC CAUSING DANGER IN ANESTHESIA.*

F. D. BULLARD, M.D.,
LOS ANGELES, CAL.

I purpose in this short paper to emphasize the importance of the personal equation, both of the operator and of the anesthetist, for the successful outcome of a surgical procedure.

The first important quality in the anesthetist is a sane confidence in himself. He should not be overconfident, rash or presumptuous. Such a one is either ignorant from inexperience, or constitutionally unfit to undertake so dangerous a specialty. On the other hand, he should not be so timid as to fail in obtaining an anesthesia or in securing its even continuation. Experience may convert the timid man into a conservative yet efficient one, but no number of cases can render the unthinking and rash person a safe anesthetist. The anesthetist should feel that he is the pilot to whom has been intrusted the ship of life while it is sailing a dangerous shore. Hence eternal vigilance is the price of a safe voyage.

He must choose the form of anesthesia, the kinds of anesthetic to be used, and the depth of anesthesia to be maintained. He, therefore, should know the surgical procedure intended or undertaken, so that he may employ the proper prophylaxsis, issue the required warnings, and govern his management accordingly. It is essential then that the surgeon have faith in the ability and good judgment of the anesthetist, so that he may calmly and confidently perform his work, knowing there will neither be unwise interference or dangerous acquiescence. The surgeon and the anesthetist must be in thorough accord. During the operation the anesthetist must be equal to the surgeon, and in anesthetic emergencies commander-in-chief. The anesthetist must not be afraid of the operator. He should, I believe, be a physician, be well informed, of sufficient experience to justify a sane and well-grounded confidence in himself, thoroughly familiar with the technic of handling emergencies, and of sufficient personality to dominate the situation.

It is exceedingly important that the patient should put implicit trust as far as possible in the skill and ability of the anesthetist. The anesthetist then must by no means be deficient in the power of inspiring confidence. He stands more in need of tact than any other specialist. He should know almost intuitively how to approach the individual patient. Each occasion will usually put in the anesthetist's mind the appropriate suggestion. Proper encouragement, gentleness, and persistent firmness must be judicially mixed with the administration in order to produce a safe and sane anesthesia.

Having had, by hospital or other training, sufficient experience to inspire confidence in himself, in the operator, and in the patient, and being endowed by nature with a fair amount of tact, the safe and successful practitioner of this art must have the power of keen observation and prolonged concentration. He must not only be able to see the phenomena taking place, but capable of giving the proper interpretation thereto. This power of making a quick and correct decision is a very essential quality of the anesthetist. He should know instantly how to apply the indicated remedy at the correct time in the proper manner.

Above nearly everything else the anesthetist must have the faculty of prolonged concentration on one subject, so as to never be so wearied by monotony as not to know just what is going on all the time, hence his attention should never be distracted. The lack of intelligent continuous watchfulness is the chief cause of both failure and fatality.

A very necessary characteristic for the anesthetist is coolness under alarming conditions. However grave the emergency, he should never get *rattled.*

The ideal anesthetist should be well informed, confident, tactful, observing, judicial, quick to act, watchful and cool. I believe also he or she should have a full medical training. Such a person who has developed an aptness for this dangerous and absolutely essential work should be treated by the surgeon, the profession, and the laity in an appropriate and dignified manner. Professional honors and adequate financial recompense should be his reward.

Years ago the phrase *"only an anesthetist"* was a disparaging term. We older men had to face these unfair conditions. Later a more becoming dignity has been awarded the anesthetist.

If, however, the profession wish to have trained men and women devote their time to this specialty they must see to it that a sure and commensurate financial reward be given these devotees. The anesthetist during an operation suffers more from strain and weariness than the operator. The surgeon has variety, the anesthetist monotony. I have been much more wearied by giving a prolonged anesthetic than in performing a double mastoid operation.

Hitherto *"giving an anesthetic"* and *"teaching school"* have been stepping stones to higher profes-

* Read during the Third Annual Meeting of the American Association of Anesthetists, San Francisco, Cal., June 21, 1915.

sional attainments. Both of these specialties are worthy of permanency, honor, and financial reward. If the people desire competent educators and reliable anesthetists they must pay them. There should be no lowering of either standard or reward.

Before dismissing this part of my subject, I will, like Silas Wegg, drop into poetry and say to the anesthetist:

Close watch the flowing crimson tide,
With touch upon the pulse applied
To know its meaning well.
If it go fast, if it go slow
Its number, rythm, tension know,
For they the life gauge tell.

The hues that mantle on the cheek
Conditions of the blood bespeak,
Observe with anxious care.
Then ever keep the mind at work,
Nor let it tire nor let it shirk,
Nor wander otherwhere.

Note well sleep's elder brother,—Death
Awaits the shallow faltering breath.
Beware the open pupil, still;
Beware the muscles that are lax,
The jaw that lags or tumbles back,
Such symptoms bode but ill.

That man is blind as he can be
Who seeing all there is to see,
Observing does not understand.
Then keep the mind alert and keen,
Quickly decide on what is seen,
All things hold firm in hand.

Be not o'er timid nor o'er bold,
As coward or as dolt enrolled.
Maintain an even sleep,
The surgeon then will give you praise,
The patient too will bless your days,
And you your job will keep!

If things go wrong, be calm and cool,
Be rattled not, nor play the fool,
Work on a well-laid plan.
And in the end have sand and sense
To ask a proper recompense,
Be reckoned as a man!

The other personal factor that may be dangerous to the patient is the operator himself. Anything that the surgeon does that needlessly shocks the patient, or prolongs the operation without just cause, should be avoided. The true surgeon is fully aware of the fact and is, I am pleased to say, as time goes on, more and more in evidence. There are, however, several varieties of undesirable surgeons, some of whom I will briefly mention.

Under this head I will speak first of the presumptuous surgeon. He who assays to do an unnecessary operation, or he who attempts to do too much at one time, one operation after another just because the patient is under an anesthetic. Many a patient is severely shocked, and some may undoubtedly lose their lives on account of this culpable practice.

Closely allied to this man is the too timid operator, or the very slow and tedious worker who putters around wasting valuable time, and contributing to the dangerous condition of the patient.

Quite like these two is the unprepared operator who must always wait for the sterilization of forgotten instruments. The surgeon who stops and consults over every little detail, and the man who desires to make a grand-stand play by lecturing to visiting physicians and spectators, may, under some circumstances, be very detrimental to the patient's welfare. The meddlesome physician who insists on the employment of the improper vapor or drug (especially the old-fashioned champion of chloroform), may become a grave complication in anesthesia. The ignorant man who has no business to operate at all is not often met with; he, of course, is the most fatal in his faults, but his manifest incompetency curtails his field of action

By far the most common variety of the undesirables, and hence the most dangerous of them all, is the rough surgeon. Unfortunately, this operator is utterly unconscious of his fault. Unseemly haste, the desire to make a grand-stand play, fear of the anesthetic, the consideration of mechanical results as of prime importance, his forgetting the delicate nature of the structures involved, and sometimes a natural uncouthness of manner, are some of the contributory causes which make a surgeon rough.

The reflex irritation due to his severe manipulations not only shocks the patient, but by interfering with anesthesia, often gives the administrator a wrong impression as to the depth, thus inducing an overdose of the drug.

Another place where the operator and the anesthetist should be in accord is the preanesthetic handling of the patient. They both should agree as to the preparatory and adjuvant medication. This is especially true in reference to the administration of nitrous-oxid and oxygen in prolonged abdominal operations.

I will close this paper with a few remarks in rhyme:

The doctor that's snappy,
The doctor that's scrappy,
The doctor that scolds every day,
Whose mouth's full of curses,
Who rattles his nurses,
Makes many a deadly delay.

The professional hawker,
The slick and glib talker,
Whose restless tongue nothing can balk,
Commits many a crime,
Wasting valuable time,
With a patient in surgical shock.

The man who insists,
That the anesthetist
Should give the wrong vapor or drug,
Had far better quit,
If he hasn't the wit,
For safety to muzzle his mug.

The very worst saying—
More people betraying,
Than anything under the sun,
Is, "just give a whiff
Of chloroform" if
There's nothing much to be done!

The unprepared man
With no well-laid plan,
Who new tools must e'er sterilize,
Who loiters and waits,
Who stops and debates,
Has a job too big for his size.

That too timid cutter
Who does nothing but putter,
Accomplishes naught, I am sure,
But it is pathetic
How much anesthetic
The poor patient has to endure!

Let Sir. Surgeon Fixit
Be shown to the exit,
Who does operating galore,
Who does one thing then tother
Right after the other
And cries when there isn't some more.

The surgeon that's gruff,
The surgeon that's rough,
The surgeon that pummels and mauls
The shrinking intestines
Is as bad as ten pests in-
Side the abdominal wall!

And the doctor that's sore
Who hollers "give more,"
Whenever the patient may flinch,
May himself be at fault
By his heavy assault
That causes his patient to wince!

When wearied and harried
By thrusts no more parried
The patient succumbs and is dead,
The surgeon will wonder
And blame all his blunder
Upon the anesthetist's head.

SPINAL ANESTHESIA.*

JOHN OVERTON, M.D.,
TULSA, OKLAHOMA.

In attempting to discuss the subject of spinal anesthesia or as some prefer to call it, spinal analgesia, I expect to do so as nearly as possible from an unprejudiced standpoint, giving it credit for what it is worth and emphasizing its danger. When we go over the various methods of anesthesia we must realize that so far there is no one that is satisfactory and safe for all classes of cases. Dr. Keen of Philadelphia has said that "The ideal anesthetic must be one that will abolish pain by the abolishment of consciousness but without danger to life." Many others of less prominence no doubt have expressed the same opinion, and we all must agree that this is the desired solution.

Spinal anesthesia has been taken up and used in the clinics of many skilled and careful surgeons; some who began its use with enthusiasm have given it up almost entirely; others have continued to use it with great success and increasing satisfaction, progressively extending its application. Probably there has been error in judgment on both sides, but I do not feel that it should be subjected to such extreme criticism as to make its use a just cause for malpractice, or to class it as a surgical *stunt*.

HISTORICAL CONSIDERATIONS.

In 1885 Corning, of New York, first used cocain in proximity to the dura about the spinal cord. Later he used subdural injections for relief of irritable conditions of the cord. In 1898 Bier, of Berlin, first used it in the production of anesthesia for surgical reasons. He was very careful in his work and warned against its too general adoption. Unfortunately, as so often occurs with new surgical methods, there was a careless and poorly considered application of this procedure. As a result there were a number of fatalities and permanent unpleasant sequelæ.

It was then generally given up. However, a few continued its use carefully considering its indications and guarding against its dangers. Among such may be mentioned Bier of Berlin, Tuffier of France, Barker of England, Morton, Babcock, Bainbridge and Allen of this country.

Cocain was the drug first used, but on account of its toxicity it has been displaced by safer preparations, notably stovain, tropacocain and novocain. Injection below the lower end of the cord has been the most common and widely used method. Recently injections above this point have been used by Babcock. He thinks it best to inject as near as possible to the nerves distributed to the field of operation. Jonnesco, of Budapest, used stovain in combination with strychnin and injected at any point in spinal canal. He had a large number of cases with very favorable results, however, few have been willing to follow him.

INDICATIONS AND CONTRAINDICATIONS.

A safe rule, especially for those beginning this work, is to select only those cases in which a general anesthetic is positively contraindicated, local or regional anesthetic inadequate and operation one of necessity and not of choice. There is a wide difference of opinion according to the literature in just what conditions it is indicated and in what contraindicated. Some advise its use in severe cardiac, pulmonary and renal disease; in the old, in the weak exhausted cases and in those cases where we anticipate a long severe operation. It is adapted to

* Read during the Organization Meeting of the Interstate Association of Anesthetists, at Cincinnati, O., May 4-5, 1915.

prostatectomy in old men, in operations on the external genitals, rectum, and lower extremities, in diabetes, and in cases of acute peritoneal sepsis and paralytic ileus. I believe it also suitable for examination of tubercular bladder, and in some cases of intestinal obstruction. It is contraindicated in cases of myocardial disease, especially associated with obesity; in advanced arterio-sclerosis where we have reason to believe that the cerebral vessels are particularly affected; in cases of acute hemorrhage and shock with lowered blood pressure. Most believe it should not be used in very young, nor where we have cerebrospinal disease or some anomaly of the spine. Of course it should never be used where there is any infection close to the point of puncture. Where pyemia exists it is also thought to be contraindicated.

One case of tubercular meningitis being reported, which developed following its use in a case of tuberculous knee. It should never be used with those who have any aversion for it. Let it be understood that all do not accede to the foregoing indications and contraindications.

Babcock claims it should never be used in cases that cannot stand a reduction in blood pressure, or those in which artificial respiration cannot be instituted for their relief, if indicated. The same author after studying his statistics and those of others, obtained through personal communication, has not found much difference in the mortality of ether and of spinal anesthesia. He also claims that with proper technic and pure drug there are fewer morbid results following the use of spinal anesthesia. It has a number of disadvantages, among which are, that it is not applicable to all cases; that it fails in a small percentage of cases; that the dose cannot be diminished after once being given; that only those who have specially prepared themselves and have developed a perfect technic should use it.

DANGERS AND COMPLICATIONS.

We must realize the possibility of death from respiratory paralysis, as well as temporary and permanent disabilities from paralysis of various groups of muscles. Symptoms of collapse may arise during anesthesia such as air hunger, faintness, disturbed vision, weak, rapid pulse, free perspiration, nausea and vomiting. It may be followed by symptoms of meningism, sleeplessness and various paresthesias, backache, acute decubitus and gangrene, transient nephritis, chronic neurasthenic state, and prolonged stubborn headache. Few cases have elevation of temperature, which is thought by some to be due to irritation of the heat center. There may be a complete relaxation of the sphincter or there may be retention of urine.

The treatment of collapse is to raise the head and shoulders, give stimulation by strychnin, caffein, oxygen, saline transfusion and pressure on abdomen. If symptoms of respiratory paralysis develop we should institute artificial respiration and keep it up until after the heart has stopped. Of course the best treatment would be to closely observe the height to which anesthesia reaches; and to raise the head and shoulders, should it go as high as the clavicle or involve the arms. To prevent the sequelae we should use preparations that are fresh and prepared according to strict instructions. By these means we will avoid much inconvenience and anxiety to ourselves and best guard the safety and permanent health of our patients. This applies if the solution is not lighter than spinal fluid, if lighter the patients' head is lowered, artificial respiration and stimulants carried on.

AGENTS FOR SPINAL ANESTHESIA.

At present stovain, tropacocain and novocain are the drugs used. From evidence obtainable through reading it appears that tropacocain is the safest. Stovain, however, has been used in a very large series of cases by Babcock of this country and Barker of England. These drugs may be used alone or in combination with suprarenal preparations. There is a disagreement, however, in reference to this point. Some think that suprarenalin better localizes the effect of the anesthetic as well as enhances it. Others believe that it is unsafe to use it, because of the unstable nature of the suprarenal preparations and the consequent danger of injury to the nerves with resultant paralysis or trophic disturbance with decubitus. All the drugs are susceptible to sterilization by heating. This should, however, not be too prolonged. Stovain has in itself positive antiseptic properties. They are all used in five per cent. solutions, the dose being from five to seven one hundredths of a gram. Some use a solution lighter than the spinal fluid, some of the same specific gravity and some heavier. Some inject immediately following puncture, others prefer to allow the escape of five to ten c. c. of spinal fluid and then inject; others dilute the solution with the spinal fluid and return it all to the canal. It is claimed by Babcock that the anesthetic affects the nerve roots and not the spinal cord. It takes place by a chemical affinity between the nerve substance and the anesthetic drug.

METHOD OF ADMINISTRATION.

The majority put the patient in a sitting position with legs hanging over the table and back well flexed,

and since the cord ends at a level with the second lumbar vertebra, make the puncture between the second and third or the third and fourth, the latter being the safer, since the cord may possibly be lower than normal. The puncture may be made either directly in the median line or a little to the side, the needle in each case pointing slightly upward and toward the median line. It is well to use only a gold or platinum needle of the Quincke style and to withdraw the stilette before entering the subarachnoid sack, and do not attach the syringe until the fluid flows out freely. These precautions are taken, first, with the idea of puncturing the sack directly in the median line, so as not to get into either group of nerve fibers, nor to penetrate too far forward where the motor roots lie and might therefore be more affected; and lastly, to be sure the needle is well within the sack so that the solution would not be injected extradurally. The patient is allowed to remain sitting for three minutes if solution is not lighter, then is slowly put in a recumbent position with head and shoulders slightly elevated. It is generally considered unwise to elevate the pelvis too quickly. However, after fifteen minutes the Trendelenburg position may be used. Dr. Babcock in using his light solution immediately after injection lays his patient down with the table so tilted that the shoulders are two inches below level of hips. This is to prevent the upper diffusion of the drug with its consequent dangers. Barker uses a technic different from most of the others. He claims that by using a solution distinctly heavier than the spinal fluid we can definitely control the height of the anesthesia by changing the elevation of the shoulders and pelvis with the patient lying in the lateral position. He takes care that this level is not disturbed in changing into the recumbent position. He uses stovain with the addition of a little glucose, which has a specific gravity of 1.02, the spinal fluid varying from 1.003 to 1.007. It is also possible by this procedure to anesthetize only one limb. As a rule, a properly performed lumbar anesthesia is sufficient in the class of cases indicated. If not complete, it may be repeated, unless the full dose has already been given, or we may proceed with the assistance of a small amount of ether, one to two drams will frequently be enough for a long operation. Others like to use the morphin-scopolamin combination or local anesthesia in addition. All instruments should be kept only for this purpose and sterilized either with steam or boiled in distilled water, as an addition of alkalis or strong antiseptics may neutralize the effect of the anesthetic or produce irritation within the canal. We may prepare the solution fresh or use already standardized ampoules or tablets of definite amounts. The technic we have used is as follows, and is practically that of Gellhorn of St. Louis:

The patient is given the same general and local preparation as for any operation, but may be allowed to take food within a short time of going to the operating room. He is put on the table in a sitting position with legs hanging over and puncture is made between the third and fourth lumbar vertebrae. As soon as the fluid flows freely, the syringe, already filled, is attached and as much spinal fluid drawn in as we had of solution. We generally use 3 c.c. of a 5 per cent. novocain solution, but I believe we may safely use it in as strong as a 10 per cent. solution. After remaining in the upright position for three minutes the patient is gradually lowered to the recumbent posture with head and shoulders slightly elevated. In ten minutes preparation may be carried out and in fifteen the operation may be begun. The anesthesia usually lasts from one to two hours. After return to room patient should be kept recumbent and watched closely for the first few hours. This is the method we have used in a small series of cases with satisfactory results and no bad effects. Hereafter when I use this method of anesthesia I intend to use the solutions and follow the technic of Dr. Babcock.

In conclusion, let me say to those who may at some time contemplate using spinal anesthesia that unless it is a case of great emergency and nothing else will do, to study the subject carefully, familiarize themselves with every detail of technic and be as sure as it is possible to be of the purity of the drug employed. For those who have employed it widely I have no word of advice.

TO THE READERS OF THE SUPPLEMENT

THE AMERICAN YEAR BOOK *of* ANESTHESIA *and* ANALGESIA.

¶ While the Anesthesia Supplement covers the Transactions of the various associations of anesthetists, the American Year Book of Anesthesia and Analgesia will enable the surgeon, specialist, dentist, anesthetist and research worker to review all the current advances in the science and practice of these subjects, as they interest him individually.

¶ Among the contributors are: R. S. Lillie, Theodore Casto, F. C. Mann, W. D. Gatch, G. W. Crile, E. I. McKesson, Y. Henderson, A. H. Miller, A. G. Levy, R. H. Ferguson, W. P. Burdick, J. Jarvis, J. J. Hogan, J. T. Gwathmey, A. H. Warner, R. A. Rice, A. E. Guedel, J. O. Polak, F. H. McMechan, E. S. Barber, W. H. DeFord, R. H. Riethmüller, Kurt Thoma, C. W. Allen, L. . Hirschman, C. T. Souther, W. Harris, A. E. Hertzler, W. T. Porter and G. G. Smith.—*Editor.*

THE SELECTION OF THE ANESTHETIC.*

EMMET F. HORINE, M. D.,
LOUISVILLE, KY.

INTRODUCTION. New methods and many refinements in anesthesia have been brought forward within the last decade. At the present time many men in the larger cities are devoting all of their time or practically all of it to the study and administration of anesthetics as has been done in England for many years. Such work is a specialty in itself and worthy the devotion of a life time. The day has passed when a bystander, an untrained assistant or a nurse with only a mask, chloroform ether, and a tongue forceps is called upon to render unconscious, I should hardly say to anesthetize, the patient. In almost every town and even in the country there is at least one physician who has made a special study of anesthesia and who should be called for such work.

An anesthetist must be competent enough to skillfully administer any one of the well-known agents or to use any one of the reliable methods. A man who exclusively uses one drug or method is manifestly incompetent. I am convinced that even the safer agents, if given by improper methods or to unsuitable subjects, will as surely cause trouble as the most dangerous agent. A cursory analysis of anesthetic fatalities will convince one that quite often the method and not the drug must be blamed.

SELECTION OF AGENT AND METHOD.

The most important duty of the anesthetist is the selection of the agent and of the method. The following points should be considered:

(1) Dangers of the agent to be used.

(2) Applicability of the agent and method for the particular operation to be performed. The surgeon should have a free field for his work so that he may do that work with ease.

(3) The patient should be considered both from a pathological and from a psychological viewpoint. In some clinics little if any attempt is made to select the agent. Each patient receives the same treatment regardless of any indication to the contrary. This is especially true in those clinics where nurses are the anesthetists.

We have at our disposal the following methods of anesthesia: (a) local; (b) automatic inhalation; (c) intratracheal insufflation; (d) rectal; (e) spinal; (f) intravenous; (g) electric. For local anesthesia cocain or novocain combined with epinephrin is usually employed. In inhalation methods nitrous oxid, ether, ethyl chlorid and chloroform are the drugs ordinarily used. Intratracheal insufflation anesthesia may be maintained by nitrous oxid though ether is the more ordinary agent. In rectal anesthesia ether alone, though dangerous, was formerly employed but lately Gwathmey has introduced a mixture of olive oil and ether with which good results have been obtained. For spinal analgesia either novocain or stovain is now used in place of cocain which was formerly employed. For intravenous work a five per cent solution of ether in normal saline either alone or combined with hedonal (ten grains to the pint) may be employed. Solutions of paraldehyde and of isopral have also been found useful for intravenous work.

As to the degree of favor in which these methods are held, either local or inhalation anesthesia or a combination of the two is favored by the majority of men. Rectal, spinal and intravenous anesthesia each has its advocates, though these methods have not as yet received the stamp of general approval. Electric anesthesia has been found successful with the laboratory animal and also in several instances upon the human subject for local analgesia but its possibilities are as yet unknown.

Of these methods the safest is local analgesia and second to it is inhalation anesthesia. A combination of local with inhalation anesthesia as in the method of Crile would naturally occupy a place of intermediate safety.

PRELIMINARY MEDICATION.

In general it is best to administer a preliminary hypodermic of morphin and atropin or of morphin and scopolamin. In the case of an adult patient the dose should be from 1/6 to 1/16 grain of morphin and from 1/100 to 1/200 grain of atropin. When scopolamin is used the dose should be 1/200 grain or less. With children and the aged it is my rule to administer a small dose of atropin and no morphin.

DETERMINING FACTORS.

In determining what agent to use the question of safety should be the first one to consider. The comparative safety of the various agents in ordinary cases and their safety in special conditions must be considered. Not only should the drug selected entail the least immediate danger but it should also cause the fewest delayed results. It is not enough to carry our patients safely through the period of induction and through the operation but we must always consider the possible after-effects. Authorities are agreed that postanesthetic acetonuria and glycosuria follows the exhibition of ether

* Read during the Organization Meeting of the Interstate Association of Anesthetists, Cincinnati, O., May 4-5, 1915.

in a small percentage of cases, with chloroform in a large number of cases but never with nitrous oxid. The mortality for a given agent may be less than for another agent and yet for certain cases the apparently safer drug would be the more dangerous one.

The agent should be selected which will be best tolerated by the patient. The preoperative as well as the postoperative comfort of the patient must be taken into consideration.

LOCAL ANESTHESIA.

Local anesthesia is at present just coming into its own. It is undoubtedly true that the surgeon can perform his work with greater ease and rapidity when the patient is under a general anesthetic but there are many cases in which local analgesia should be used even though the surgeon must go more slowly and carefully. Without doubt general narcosis produces more or less shock, it matters not how trivial the operation may be. But it is also true that with very nervous individuals, when a local anesthetic is used, the sight of the operation may even produce more shock than a general anesthetic would. In fact death has resulted from the use of local analgesia in very nervous and weakened individuals. It therefore follows that cases for local anesthesia should be just as carefully selected as for any other method. The greatest field for usefulness for local anesthesia is in small operations though operations of any magnitude may be performed by proper attention to details. This method is of particular value in the country or in private homes when no trained assistants are at hand. In resection of a rib in empyema when the patient is very weak and septic and when the respiration and heart action are rendered difficult, the use of a local anesthetic is imperative. It is also best in patients suffering with diabetes mellitus; pneumonia; advanced phthisis; advanced renal disease; heart disease, after failure of compensation; and in all dyspnœic conditions.

NITROUS OXID.

Without the slightest doubt nitrous oxid with oxygen is the safest known inhalation anesthetic provided that it be properly administered. Nitrous oxid should never be given except by a careful and experienced person and its safety depends greatly upon whether or not it is so given. In reality nitrous oxid is a dangerous agent if employed by an inexperienced person because its zone of anesthesia is so narrow. As a routine agent, nitrous oxid with oxygen is being used by an ever increasing number of men and it deserves to be so used. But it is certainly true that there are certain conditions in which nitrous oxid is absolutely contraindicated. If administered in the face of certain contraindications it really becomes a dangerous drug and I feel that its mortality rate, slight though it is, is largely due to improper selection of the cases.

For operations of brief duration nitrous oxid is exceedingly valuable but it should never be used even for a minute unless oxygen is at hand for administration should untoward symptoms arise. As a preliminary agent to ether it is exceedingly valuable. Nitrous oxid-oxygen may be used for the majority of cases and particularly should it be used in the following conditions: diabetes mellitus, renal disease and phthisis where it is impossible to use local anesthesia. It is a very valuable agent in weak, anemic and cachectic patients as also in very nervous individuals.

In a nitrous oxid-oxygen case, if it is necessary to keep the patient cyanotic to maintain anesthesia, this agent is unsuitable. In such a case the percentage of oxygen should be increased and ether added or a change to ether alone should be made.

Mechanical obstructions of the respiratory passages are contraindications to nitrous oxid. Plethoric or fatty patients are also not very suitable subjects because of the fact that their lung capacity is small in proportion to their body weight. Athletes, heavy smokers and alcoholics are also unsuitable subjects. In children nitrous oxid does not answer so well as ether. In patients over sixty years of age in whom atheromatous conditions are usually present, nitrous oxid would entail considerable risk of cerebral hemorrhage. Those with valvular defects, dilated hearts or myocardial change should preferably not receive nitrous oxid. Thyroid cases may receive it but if the gland is large with tracheal pressure it should not be used as ether by the semi-open method is better.

ETHER.

Only second in safety to and more available than nitrous oxid ether is the best drug for general use. Of the various methods for its use, the closed, formerly so frequently employed, has been largely superseded by the various open methods. Administered by the open or semi-open method it is a very satisfactory and safe agent for the average patient. Ether given by either of these methods has the following advantages: (1) simplicity; (2) safety; (3) economy; (4) utility. A preliminary hypodermic of atropin or of atropin and morphin assists materially when ether is to be used.

Where possible the most agreeable method for ether is to use nitrous oxid-oxygen as a preliminary

agent. This sequence is very valuable with nervous and excitable patients. The period of induction is shortened, the period of visible excitement is usually absent and the amount of ether used is lessened. With this sequence I believe the preferable technic is to first anesthetize with nitrous oxid-oxygen and then gradually to add the ether vapor to this mixture until the patient is thoroughly anesthetized. Then the gas is discontinued and the open, semi-open or vapor method substituted. It must be remembered that the contraindications to prolonged nitrous oxid-oxygen anesthesia also hold good for its preliminary use before ether.

When nitrous oxid is contraindicated ether may be given from the start. It may be claimed that it is very unpleasant when so given but this is true only when improperly administered. By very gradually increasing the concentration little, if any, unpleasantness is noticed. There should not be a stage of excitement except in a very small percentage of the cases, mostly in alcoholics. If the anesthesia has been an even one there is rarely any troublesome nausea or vomiting with this method. Following Gwathmey's suggestion I have used oil of orange as a preliminary to ether. It aids materially by masking the odor of the ether. I have however not noticed that the amount of anesthetic has been thereby lessened as some observers have claimed.

Ether may be used by some one of the various methods in the majority of cases. In valvular defects, in thyroid conditions, in mouth cases and in athletes I have found it of especial value. In pulmonary conditions ether may be given but nitrous oxid or local anesthesia is preferable. It was formerly advised that ether should not be given in chronic bronchitis but if a sufficient dose of atropin is previously given no trouble will be experienced. Preferably in cases presenting a permanent high blood-pressure ether should not be given though in a few cases when it has been impossible to use any other agent I have given it without any trouble. The special indications for the use of local anesthesia mentioned in a preceding paragraph would contraindicate the use of ether. It must not be given when the actual cautery is to be used about the face.

CHLOROFORM.

For many years chloroform was given the preference over ether by the majority of men. Many investigations have been conducted to ascertain the comparative safety of these two agents. From a large number of statistics it appears that ether is not less than six or seven times safer than chloroform when the immediate mortality is considered. Chloroform is dangerous no matter by whom it is given. No one should attempt to administer it unless he has had considerable experience in anesthesia. It has certain advantages but these advantages do not, as a rule, compensate for its greater danger.

It was formerly stated that: "patients were lost with chloroform on the operating table and with ether, afterwards." But it has been proven that delayed chloroform poisoning is not at all rare. Even in dilute dosage it undoubtedly causes more or less fatty degeneration of the liver and kidneys which may lead to a fatal effect days after the operation. This is particularly likely to occur in septic cases because in these the liver and kidneys have already been overworked. Acidosis in children, and acetonuria and glycosuria in adults frequently follow the administration of chloroform. Particularly in obstetrical cases where also the liver and kidneys are already overworked, I think that chloroform should not be used.

The immediate danger from chloroform is usually circulatory in character. For this reason when it is given a phonendoscope should always be strapped over the precordia for the purpose of continuous auscultation. I have records of several cases in which the phonendoscope rendered very valuable assistance in indicating approaching danger from chloroform. Children are not safer subjects for chloroform though in case of accident they are more likely to respond to prompt measures than adults. Apparently men are more susceptible to its action than women though they may be only apparently so from the fact that a relatively larger dosage is necessary to anesthetize.

Except in the following cases chloroform should not be selected: (a) operations which require the use of the actual cautery about the face; (b) in patients presenting a permanent high blood-pressure; (c) in aneurysm; (d) patients in the Trendelenburg position take it well and if necessary for the purpose of securing relaxation it may be used in sequence to ether or to nitrous oxid-oxygen-ether; (e) obstructed air passages; (f) in all other cases *only* when it is absolutely impossible to use local or obtain nitrous oxid or ether anesthesia.

CONCLUSIONS.

In conclusion I desire to emphasize the following points:

(1) The anesthetic must be selected for each individual case.

(2) The field for local anesthesia is widening

and it is very valuable in minor surgery and for the markedly handicapped patient.

(3) Nitrous oxid-oxygen alone or combined with local anesthesia is the safest general anesthetic and should be used whenever possible.

(4) Ether must still remain the anesthetic of choice for the majority of physicians.

(5) Chloroform is dangerous and should be used only when positive indications are present for such use.

(6) Rectal, intravenous and spinal methods are still on trial.

1036 BARDSTOWN ROAD.

NITROUS OXID-OXYGEN ANESTHESIA: WITH DESCRIPTION OF A NEW APPARATUS.*

ALBERT H. MILLER, M.D.,
PROVIDENCE, R. I.

In 1772, Dr. Priestly prepared a gas which he called dephlogisticated nitrous air. Sir Humphrey Davy, in April, 1799, in the course of a series of hazardous experiments upon himself, inspired this gas in a state of purity and was rendered unconscious for about ten minutes. He named the gas nitrous-oxid and predicted its use to relieve the pain of surgical operations. In November, 1844, Horace Wells, a dentist of Hartford, Conn., imbued with the theory that operations might be performed without pain, procured some nitrous-oxid, himself inhaled the gas, and was rendered unconscious for a dental operation, administered it to a number of his patients, and immediately set out to make his discovery known to the world. To Horace Wells first came the conception of what we know as surgical anesthesia. While his public demonstration was such a failure that the disappointment resulted in his death, the inscription on his monument in Hartford is well deserved: "Horace Wells, the Discoverer of Anesthesia, December, 1844."

COMPOSITION AND PREPARATION OF NITROUS-OXID.

Nitrous-oxid gas consists of two parts of nitrogen with one part oxygen, in stable chemical combination. The atmosphere contains four parts of nitrogen to one of oxygen. In the atmosphere, the elements are not chemically combined, but form a loose mixture from which the blood readily absorbs one-fifth of the oxygen for the use of the body. While the proportion of oxygen in nitrous-oxid gas is twice as great as in the atmosphere, the combination between the two elements is so stable that the blood can obtain no oxygen from the gas.

To obtain nitrous-oxid, ammonium nitrate is heated in a retort until it decomposes into water and nitrous-oxid. The gas is purified by being passed through a solution of ferrous sulphate which absorbs any nitric oxid which may have been formed and afterward through a solution of sodium hydrate to remove any chlorin which may have been derived from the ammonium chlorid in the nitrate used. The gas is then collected in a gasometer over warm water. To facilitate transportation and preservation, it is compressed in steel cylinders to a pressure of about 900 pounds to the square inch, at which pressure the gas is liquefied.

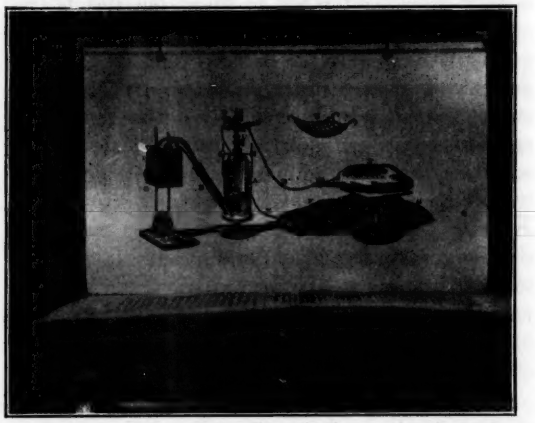

Fig. 1. Apparatus for the manufacture of nitrous oxid. From Silliman's *Chemistry*, 1830.

INTRODUCTION OF GAS OXYGEN ANESTHESIA

In 1868, Dr. E. Andrews, of Chicago, found that anesthesia induced by nitrous-oxid could be prolonged by a mixture of nitrous-oxid and oxygen. Hillischer, of Vienna, first used gas and oxygen in an apparatus capable of regulating the proportion of the gases. Sir Frederick Hewitt commenced the use of gas and oxygen in 1886. He put the administration on a practical basis and perfected an apparatus which is still in use.

ADVANTAGES.

The advantage of nitrous-oxid-oxygen anesthesia consists in freedom from after-effects. Recovery is immediate. There is no irritation of the kidneys, or the respiratory system. No fatty degeneration of the organs results. Changes in the blood are transient.

The resistance of the patient is not lowered. If there is an infection, his power is not wasted in fighting the after-effects of the anesthetic, but is ready to combat the poison. In fact, soon after the

* Read before the Providence Society of Anesthetists at the meeting of February 17, 1916.

inhaler has been taken from the patient's face, all effects due to the anesthetic have passed away.

Casto has found that "there is a tendency for the blood pressure to rise, but only when cyanosis appears. Hemoglobin is reduced, the blood index returning to normal after gas has been discontinued for from 20 to 30 minutes. The time for coagulation of the blood was decreased on an average more than one minute, returning to normal in about 20 minutes after discontinuance of the gas." (Dental Cosmos, October, 1915.)

On the contrary, Anders and Boston found a steady fall in hemoglobin for 24 hours after etherization, the index not returning to normal for several days. (Dental Cosmos, October, 1915.) Hamburger and Ewing found a marked decrease in the

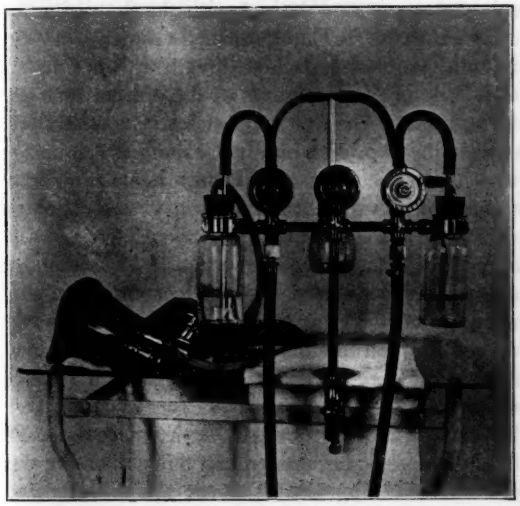

Fig. 2. Nitrous Oxid-Oxygen Apparatus. Controlling valve unit attached to table.

coagulation time of the blood following etherization, most marked from the seventh to the tenth day. The average fell from seven minutes before anesthesia to four minutes on the seventh day following. (*J. A. M. A.*, November 7, 1908).

DISADVANTAGES.

The disadvantages of gas oxygen in comparison with ether or chloroform consist of greater expense, the difficulty of securing perfect relaxation, and the narrow margin of safety, which confines the use of this anesthetic to the expert.

SAFETY.

In unskilled hands, as a routine anesthetic, nitrous-oxid-oxygen is undoubtedly more dangerous than ether. In the hands of the expert, also, the routine use of nitrous oxid-oxygen is attended by greater immediate danger than accompanies expert etherization. In selected cases, the expert can save many lives which would be forfeited under ether or chloroform anesthesia, by the use of nitrous-oxid-oxygen.

The following series of cases of nitrous-oxid-oxygen anesthesia have been reported:

Cases.	Deaths.	Observer.	Reference.
8,585	0	Gwathmey,	(J. A. M. A., Nov. 23, 1912, p. 1845.)
13,000	1	Jones,	(Ohio St. Jour. of Med., August, 1915.)
34,964	0	Crile and Lower,	(Anoci Association, p. 245.)
23,952	1	Teter,	(J. A. M. A., Nov. 23, 1912, p. 1849.)

Teter has collected 938,924 cases of nitrous-oxid, 32,172 cases of nitrous-oxid and air, and 190,724 cases of nitrous-oxid-oxygen anesthesia, a total of 1,161,820 cases, with two deaths. (Dental Cosmos, September, 1915.)

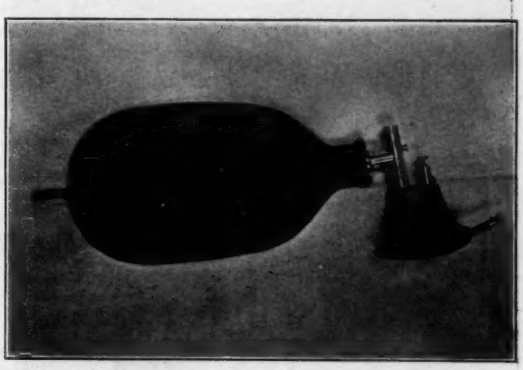

Fig. 3. The inhaler.

Altogether, 21 deaths under nitrous-oxid-oxygen anesthesia have been reported in literature; 11 of these deaths were reported as due to the anesthetic.

Dr. Mosher, of Kansas City, has carried on an extensive correspondence concerning the safety of nitrous-oxid-oxygen. He finds that many deaths under this anesthesia have not been reported in literature. (*Am. Jour. of Obs.*, December, 1915, p. 1055; February, 1916, p. 352.) This conclusion is as inevitable in the case of nitrous-oxid-oxygen as with other anesthetics.

Mosher's conclusion that there is a disposition to conceal the dangers of this anesthesia is inexcusable. Among many papers dealing with the question, that of Teter on "The Limitations of Nitrous-Oxid with Oxygen as a General Anesthetic" (*J. A. M. A.*, November 23, 1912, p. 1849), states clearly the class of cases in which this anesthetic is not indicated,

and allows that in case of a major operation when the services of an expert anesthetist with nitrous-oxid-oxygen are not available, he should prefer to take his chances with ether in the hands of an inexperienced person.

CONTRAINDICATIONS.

Gas oxygen is contraindicated in children under five years of age on account of the small size of the respiratory passages and the increased liability to asphyxial symptoms. For the same reason, it should not be used in cases of enlarged tonsils, cellulitis, or tumor of the neck, or any other respiratory obstruction. It is contraindicated by bad heart lesions with broken compensation, by aneurism, emphysema, and marked arterio-sclerosis. Nitrous-oxid-oxygen is not a satisfactory anesthetic when perfect relaxation is desired in healthy subjects.

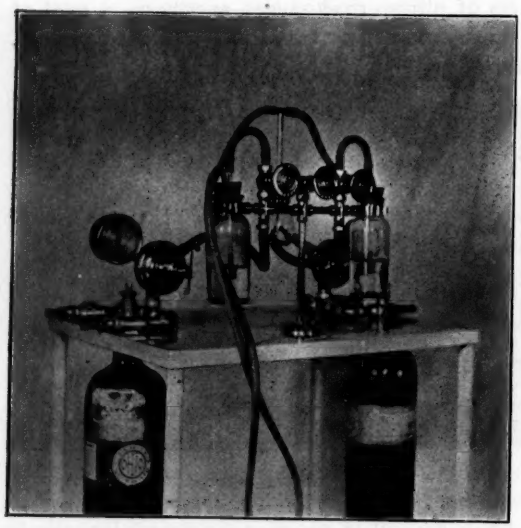

Fig. 4. Nitrous Oxid-Oxygen Apparatus permanently attached to table.

INDICATIONS.

On the contrary, this anesthetic is especially desirable in anemia and in all acute infections. With impaired kidneys and in respiratory affections, it should always be considered. In bad surgical risks, as in grave general peritonitis, or in the presence of shock, it is the anesthetic of choice. It should be extensively used in minor operations and manipulations and for operations on the extremities. In obstetrics, it should be used far more than at present. In Cæsarean operations, it is the anesthetic of choice. Only the simplest and shortest cases may be safely undertaken by the beginner.

APPARATUS.

In the literature of the last few years, 27 forms of apparatus for the administration of gas and of gas oxygen have been described. In 1909, Teter reported a series of 13,000 administrations of nitrous-oxid-oxygen covering a period of nine years. He used an apparatus providing for warming the gas and for adding ether vapor to the mixture. He perfected a nasal inhaler and called attention to the advantage of having two cylinders of each gas connected to the instrument. Gatch showed the harmlessness of rebreathing. Henderson showed the physiological advantage of rebreathing. McKesson evolved the principle of fractional rebreathing, saving the first part of each expiration and allowing the last part, laden with carbon dioxid and deprived of much of its oxygen, to escape. Boothby devised a simplified apparatus providing a regular flow of each gas at any rate desired with the flow of gases rendered visible. The combined supply and rebreathing bag was attached directly to the inhaler.

The gas oxygen apparatus of the present time are of two types. The first type of instrument is characterized by two bags, one for gas and one for oxygen. The patient, at each inspiration, draws in a mixture of gas and oxygen through valves which modify the percentages of the two gases. In the second type of apparatus, the gas and oxygen under pressure are introduced into one bag in the proportion required. The patient inspires from this bag the mixture already made. The instruments also differ in other respects: the use of reducing valves to control the high pressure of the gases as furnished in cylinders; devices for keeping the bags of the two-bag apparatus equally filled; heating devices for warming the mixture; attachments for vaporizing ether supplied by an automatic dropper or by passing the mixture over the surface of liquid ether in a container; rebreathing into a separate bag or into a supply bag; intermittent or fractional rebreathing; different forms of face piece with or without an air valve or an inspiratory valve.

NEW APPARATUS DESCRIBED

The nitrous-oxid-oxygen apparatus here described provides a definite flow of nitrous-oxid and of oxygen, each measured in liters per minute, to which may be added a definite flow of ether vapor. Two reducing valves, one for nitrous-oxid and one for oxygen, are provided. Each reducing valve is mounted on a double yoke. The cylinders of each gas, clamped into their yokes, set on the floor, not requiring any other support. The reducing valves furnish a supply of nitrous-oxid and of oxygen at a constant pressure of 10 pounds to the square inch. The reducing valves are connected with the controlling valves by rubber tubing.

A frame which supports the controlling valves and indicators is provided with a clamp which serves to attach this part of the apparatus to a table or chair, doing away with the need for a stand. On the frame are mounted three needle valves, two wash bottles, and a vaporizer of special construction. Oxygen passes through the valve and wash bottle on the left, and nitrous-oxid through the valve and bottle on the right. The wash bottles serve as indicators of the flow of nitrous-oxid and oxygen and also moisten the gas. Dials attached to the stems of the needle valves are calibrated in liters per minute of flow of nitrous-oxid and of oxygen. The middle needle valve transmits a stream of nitrous-oxid to a vaporizer which furnishes a constant percentage of ether vapor varied by changing the rate of flow of the gas. One liter of gas vaporizes in this way 5 c.c. of liquid ether in a minute. The controlling valve unit is connected with the inhaler by rubber tubing. The mixture of gases is made close to the inhaler. No mixing chamber is provided.

The inhaler has a face piece of celluloid with an inflatable rubber cushion and a cuff. The air valve on the inhaler is open when the gas is shut off and vice versa. The face piece may be adjusted to the face, so that the patient becomes accustomed to breathing through it before the anesthetic is introduced. The adjustable inspiratory valve provides for administration without rebreathing, for fractional rebreathing, or for intermittent rebreathing. The expiratory valve is mounted on the inhaler in plain sight and is controlled by a spring of adjustable tension. The supply and rebreathing valve is mounted directly on the inhaler. The inhaler may be quickly separated into parts which may be sterilized in boiling water, dried inside and out, and readily assembled. The wide mouth of the supply bag allows of its being turned inside out and dried.

With fractional rebreathing, the first part of each expiration passes into the supply bag and is rebreathed. The latter part escapes through the expiratory valve. The proportion of rebreathing varies inversely as the rate of flow of the mixture into the inhaler. This proportion can be closely estimated by noting the point in expiration at which the expiratory valve opens. Only enough tension on the expiratory valve is maintained to insure the filling of the bag before the valve opens. The apparatus may be packed in a 24-inch suit case for transportation. It may be permanently atached to a table for hospital use.

279 Benefit Street.

Book Reviews

A carefully selected library is essential to a thorough knowledge of the science and practice of a specialty.

The American Year-Book of Anesthesia and Analgesia. By Various Contributors: F. H. McMechan, A.M., M.D., *Editor*. Quarto; art buckram; India tint paper; p. 352, and 250 illustrations. Surgery Publishing Company, New York City, 1916. $4.00.

The Year-Book is another indication that anesthesia and analgesia are coming into their own. While the Quarterly Supplement provides a journalistic medium for the publication of the Transactions of the various associations and societies of anesthetists, the Year-Book collates the more ultra-scientific researches and the invaluable technical advances in these subjects.

The list of contributors to the initial volume is notable.

Lillie's chapter on the Physico-Chemical Basis of Anesthesia is the most exhaustive and authoritative exposition of the theory of narcosis so far published. His work in this connection is gradually securing him international recognition.

Casto revives the problems of Blood Changes under Anesthesia, and while contributing his personal investigations, includes in detail those of Crile and Menten on H-ion content and Mendenhall's on coagulation time as affected by different anesthetics.

Mann reviews the various theories of Shock and details his researches into its peripheral origin; while Gatch amplifies these experimental conclusions by applying them in a practical manner to Circulatory Disturbances under Laparotomy due to the Operative Procedure, Posture and Anesthesia.

Crile's *safety-first* procedure of intermittent clamping of the carotids in head operations is impressively fortified by his personal studies in Anesthesia, Anemia and Resuscitation. The lessons taught are invaluable to surgeon and anesthetist alike.

McKesson, writing from an experience of some 6,000 personal observations, gives a comprehensive resumé of the application of blood-pressure readings as a guide to the patient's condition under anesthesia, and more especially as an indication of what constitutes operative trauma.

Henderson reconstructs the physiology of respiration in respect to anesthesia and the incidence of acapnia, apnea and anoxhemia, and his chapter is illuminating in that it dovetails his theories into the underlying physiology of anesthesia in such a manner as to obviate the conflict of opinion, which his contentions have heretofore aroused.

Miller, who may almost be termed the statistician of the subject, contributes an interesting paper on Mortality under Anesthetics and includes many considerations aside from mere tables of figures.

The fact that deaths from chloroform still form the vast proportion of fatalities under anesthesia makes Levy's investigation of Cardiac Fibrillation and Chloroform Syncope particularly apt, and calls for the abolition of adrenalin in connection with chloroform anesthesia and a modification of the tendency to administer this anesthetic in attenuated percentage vapors.

Likewise the incidence of Late Chloroform Poisoning, and its dependence on the action of the alkyl halids is handled in a masterly manner by Evarts Graham.

Ferguson, Burdick and Jarvis deal with the psychic and esthetic factors of anesthesia, and their suggestions regarding the handling of patients, the use of music and the influence of surroundings are worthy of being more generally utilized.

Hogan, who has collaborated with Fischer on the causes of edema, gives a vital interpretation of Kidney Function under Anesthesia in this connection, and suggests not only many prophylactic and remedial measures for meeting emergencies, but also includes valuable dietetic pointers.

That portion of the Year-Book devoted to the *science*

(*Continued on page* 91)

American Journal of Surgery

QUARTERLY SUPPLEMENT *of* ANESTHESIA *and* ANALGESIA

Surgery Publishing Co.

J. MacDONALD, Jr., M.D., President and Treasurer
92 WILLIAM STREET - NEW YORK, U. S. A.

Original Articles, Clinical Reports and Experimental Researches on the Theory and Practice of Anesthesia and Analgesia, as well as pertinent Society Transactions, are solicited for exclusive publication in this Supplement.

Typewritten Manuscripts facilitate Editorial Revision and avoid errors.

Subscribers Changing Address should immediately notify the publishers of their past and present locations.

Half-tones, Line-etchings and other Illustrations will be furnished by the Publishers when Photographs or Drawings are supplied by the Author.

F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Cincinnati, Ohio, U.S.A.

JULY EDITORIALS. 1916

ANESTHESIA, ANALGESIA AND THE WAR.

Chloroform, owing to its efficiency, compactness and ease of transportation, retains its erstwhile superiority, as *the* anesthetic of war. The bulk and explosiveness of ether render it less desirable as a routine agent. That a staggering amount of these anesthetics has been used since the beginning of the world's war, is evidenced by the exhaustion of the reserve supplies in the home markets and the rapid rise in prices. The Red Cross has materially assisted in depleting local supplies by its humanitarian shipments abroad. However, hospitals in the United States are virtually being saddled with an enormous war tax on necessary drugs and surgical supplies, although we are not participants in the conflict.

It is interesting to note that French surgeons are turning to ethyl chlorid as a remarkably satisfactory anesthetic for brief narcoses, necessitated by the dressing of unusually extensive and painful wounds. They are also using the Gwathmey technic of ether-oil colonic anesthesia, especially for operations about the head, face and neck. Crile took a supply of nitrous oxid-oxygen with him to France to demonstrate its superiority over all other anesthetics in surgery complicated by shock. But it proved difficult of administration in some instances on account of the mild, alcoholic taint of the wine-drinking soldiers. Compressed gases are too cumbersome and expensive as anesthetics in war surgery; although nitrous oxid-oxygen will probably hold its own in the larger base hospitals, when a supply is available. It seems a travesty on civilization that some of the manufacturers of nitrous oxid for the alleviation of suffering humanity should have turned to the manufacture of chlorin for *gassing* the enemy. A campaign, on the part of these manufacturers, to extend the use of nitrous oxid-oxygen anesthesia would have been better for all concerned.

Shock has been very prevalent as a complication of this war's surgery. It has been combated by camphor in oil and morphin injections in the field and by rather complete and persistent morphinization at the base hospitals. Strange as it may seem, shell-shock has been treated by general anesthesia with considerable success. Although this is in line with the treatment of electric-shock monoplegia in a similar manner. Occasionally exsanguination has been counteracted by saline infusion directly into the severed vessels during amputation. Coagulen has established itself as a dependable prophylactic for the incidence of hemorrhage and its control. The *axillary* sup has also proved to be the most efficient method of hypodermoclysis.

Early in the war the Germans announced an apparatus for handling large numbers of cases under local analgesia. Owing to the character of the war-wounds and the prevalence of infection, local analgesia has not been used as extensively as had been anticipated. The supply of novocain is almost at the vanishing point in this country, and surgeons and dentists have had to turn to cocain (of which there is none too much), and quinin and urea hydrochlorid. Efforts have been made to influence the German government to raise its embargo on the exportation of certain drugs. It may be, however, that the cargo of 15,000 tons of coal-tar dyes, released for export, recently, may contain a sufficient supply to tide over our requirements until the end of the war. Owing to the abrogation of treaty and patent rights, England, at the beginning of the war, began the manufacture of a substitute, and anocain is now obtainable in any desired quantity in Canada.

The drug situation in the United States, precipitated by the world's war, calls for action on the part of Congress, to so modify existing patent laws, so that necessary products must either be manufactured in this country, or in case of the cessation of importation for any cause, patent rights would lapse, pending the resumption of the supply. A concerted action on the part of the medical and dental professions might accomplish much in this respect. Several state associations have initiated such a movement, but it requires the full force and activity of national organizations to make such a reform effective.

In the present trend toward preparedness it seems advisable that expert anesthetists, medical and dental, should form a definite percentage of the membership in the medical reserve corps. Anesthesia in the world's war has involved a greater risk of life than in any previous conflict, and numberless cases have presented, in which the technic of administration was extremely difficult. Expert anesthetists are as vital a necessity in the surgery of war as in the surgery of peace.—F. H. M.

Book Reviews

(*Continued*)

of anesthesia and analgesia is concluded by Warner's illustrated article on the manufacture of a purified nitrous oxid for hospital use. Any hospital desiring to install a plant will do well to follow Warner's plan, as it has been adopted in detail by several of the largest commercial manufacturers.

An exhaustive article on Ether-Oil Colonic Anesthesia, by its originator, Gwathmey, opens that portion of the Year-Book devoted to the *practice* of anesthesia and analgesia. It is interesting to note that this new technic has become so rapidly popular that it is being used in many of the war hospitals, especially for operations on the head and neck.

As ether is still the routine anesthetic, Rice illustrates the Perfected Methods of its use; and details those improvements that time and experience have made in some consistently abused technics.

Guedel, who was among the first to use nitrous oxid analgesia in minor surgery and obstetrics, adapts the newer anesthesia for normal and pathological labor to the capacity of the general practitioner, and for the specialists, he offers a thorough consideration of its mode of action under all circumstances. Polak reviews the adaptability of Alkaloidal Amnesia for the same purpose.

The surgeons, anesthetists and dentists who have to deal with oral surgery will appreciate the chapters on these phases of the subject by McMechan, who considers the Nasal Administration of Nitrous Oxid-Oxygen; Barber, who illustrates the handling of the Obstreperous Dental Patient; DeFord, who describes the use of Somnoform in Dentistry; Riethmüller, who elaborates on his Further Researches in Novocain-Suparennin Anesthesia, and Kurt Thoma, who applies the Intra and Extra-oral Methods of Conductive Anesthesia to dental procedures, especially apiectomy, and uses *x*-ray pictures to illustrate the position of the needle during injection. Hertzler, who has done more to solve this problem than any other investigator, concludes this symposium with a consideration of Local Anesthesia and After-Pain.

Local anesthesia in its essentially surgical aspects receives attention in the articles by Allen on Prostatectomy; Hirschman on Rectal Surgery; Souther on Hernia, and Harris on Injecting the Gasserian Ganglion. The articles of Allen, Hirschman and Souther are profusely illustrated and many new points in the technic of infiltration as well as the surgical conduct of the operative procedures under local anesthesia are given.

The volume concludes with Porter and Smith's personal researches in spinal anesthesia and Smith's application of the method to Urology.

If the succeeding volumes approach the initial in scope and character of contents, authority of contributors, and wealth of illustration, the Year-Book should find a place on the desk of every progressive surgeon, specialist, anesthetist, dentist and research-worker, as an invaluable reference volume on the current advances in the science and practice of anesthesia and analgesia.

A Manual of Surgical Anesthesia. By H. BELLAMY GARDNER, M.R.C.S., L.R.C.P., London, *Second Edition;* cloth, pp. 220, 16 plates and 36 illustrations. WM. WOOD & Co., New York.

In his Second Edition, Gardner has remodelled and in part rewritten his manual, especially the chapter relating to the Cardinal Principles for Anesthetic Administration. Several chapters of new material, describing the methods of producing spinal analgesia, ether infusion and intratracheal insufflation anesthesia, and also the system of anoci-association, have been added, with new figures and plates to illustrate them.

Gardner is still an ardent advocate of the obvious and he reiterates the importance of maintaining the freedom of the airways during anesthesia.

The entire field of general anesthesia is adequately covered, both for the surgical as well as for the dental anesthetist. If he is anything, Gardner is a master-technician and his methods of inducing, maintaining anesthesia for every conceivable operative procedure should be studied with attention and may be followed with routinely satisfactory results. His advice in all instances is intensely practical and he handles the intricacies of his subject in a most understandable manner.

He is at his best in developing the team-work, so necessary between operator and anesthestist, in the administration of anestesia for oral surgery. While the English apparatus illustrated seems crude in comparison with some American devices for administering nitrous oxid and oxygen, Gardner's technic is painstakingly detailed, accurate and withal simple.

No other volume on anesthesia carries such a trenchant lesson of self-perfection to the reader, fortified with so many means for attaining proficiency.

Proceedings of the Royal Society of Medicine—Section of Anesthetics: Vol. VIII. Octavo, Cloth, pp. 24. LONGMANS, GREEN & Co., London, 1915.

This diminished volume is one of the pathetic reminders of the inroads of the world's war on the scientific activities of the Continent. The Transactions of the meetings of February 5 and March 5 are printed. The only stated paper is one on "Anesthetic Ether," by Horace Finnemore, and the remainder of the volume is devoted to two discussions, one on "The Methods of Induction of Anesthesia," the other on "The Influence of Preliminary Narcotics." It is to be hoped that an early peace will shortly bring about the resumption of the Section of Anesthetics.

The Self-Administration of Nitrous Oxid. By ARTHUR E. GUEDEL, M.D., Superintendent Protestant Deaconess Hospital, President Indianapolis Society of Anesthetists and Fellow of the Interstate Association of Anesthetists. Paper, pp. 80, with 4 illustrations. THE AUTHOR, Indianapolis, Ind., 1915. $1.00.

As the pioneer of the *self-administration* method of nitrous oxid anesthesia and analgesia, Guedel has condensed a vast amount of personal experience in his brief, but interesting, monograph. After discussing the chemistry and physiology of nitrous oxid and its effects on the organs and systems of the body, Guedel launches into a differentiation of analgesia and narcosis and shows how the self-administration of analgesia is available for many procedures commonly conducted under surgical narcosis. He favors air an a diluent, because air and nitrous oxid suffice for all the purposes to which he has put the method. Aside from its efficiency it is one of the most economical methods of analgesia.

Considering the fact that Evans of Buffalo is using analgesia as a routine in major surgery, it is not surprising that Guedel finds the air-nitrous oxid analgesia available for all the exegencies of minor surgery and obstetrics, and dentistry. The chapters devoted to the technic of administration are full of valuable pointers. The handling of emergencies, accidents and complications is considered in detail and prophylactic measures are indicated. The monograph closes with a description of the simple apparatus which Guedel has found amply serviceable in his work.

This volume will appeal to those who wish a brief, concise and practical exposition of the self-administration of nitrous oxid.

The Art of Anesthesia. By PALUEL J. FLAGG, M.D., Lecturer in Anesthesia, Fordham University Medical School; Anesthetist to Roosevelt Hospital; Instructor in Anesthesia to Bellevue and Allied Hospitals, Fordham Division; Consulting Anesthetist to St. Joseph's Hospital, Yonkers, N. Y., and formerly Anesthetist to the Woman's Hospital, New York City. Cloth, 341 pages, 136 illustrations. J. B. LIPPINCOTT Co., Philadelphia and London, 1916. Price, $3.50.

Flagg's book is intensely original. He approaches his entire subject from a personal viewpoint and develops it from the results of a large experience. Flagg maintains that anyone can administer anesthetics but that the *art of anesthesia* implies an intimate knowledge of general medicine, pathology, surgery, therapeutics, psychology and

special branches. The necessity and value of this knowledge is continually indicated in the text.

The history of anesthesia is briefly reviewed and considerable new material about Dr. Crawford W. Long and his use of ether introduced. A résumé of the entire field of general anesthesia follows. A classification of the stages of anesthesia, based on circumstances present in all methods and common to all anesthetics, with regard to induction, maintenance and recovery, is given in detail and developed by means of a series of original charts and tables. This classification forms a basis upon which the students or practitioner may intelligently attack the problems of the signs of anesthesia, which control the administrative phases. Flagg applies the researches of Connell and Boothy on anesthetic tensions to the proper interpretation of his charts.

Etherization is exhaustively handled. The various methods of administration, oral, intrapharyngeal, intratracheal, rectal and intravenous, are fully discussed. The other general anesthetics receive due consideration, especially nitrous oxid in combination with oxygen and ether and in sequence or association with other methods.

Local and mixed anesthesia are touched upon. Especial attention is paid to preliminary medication, carbon dioxid rebreathing and the control of untoward incidents. Flagg concludes with a chapter on the Point of View of the Patient, which is illuminating.

The volume is clearly printed on special paper, and elaborately illustrated. Various postures are pictured in detail.

To those who wish to be stimulated into a review of and a newer outlook upon some fundamentals in anesthesia from an original viewpoint, Flagg's book will come as a welcome relief from the text-books which are compilation from previous works.

Society Proceedings

Membership in a society devoted to your specialty is an essential to success.

AMERICAN ASSOCIATION OF ANESTHETISTS.

The Fourth Annual Meeting of the American Association of Anesthetists was held in Detroit, June 12, with the largest and most enthusiastic attendance since the organization. The following officers were elected for the ensuing year: President, Dr. Walter M. Boothby, Boston, Mass.; Vice-Presidents, Dr. F. W. Nagel, Montreal, Canada, Dr. Albert H. Miller, Providence, R. I., and Dr. Mary Botsford, San Francisco, Cal.; Secretary-Treasurer, Dr. James T. Gwathmey, New York City; and Members of the Executive Committee, Dr. Ansel M. Caine, New Orleans, La., and T. Drysdale Buchanan, New York City.

All the stated papers of the scientific program were read, without exception and extensively discussed. As these will be printed in full in the SUPPLEMENT, they need not be detailed in this report.

One of the interesting incidents of the meeting was an invitation extended Dr. S. J. Meltzer of the Rockefeller Institute to speak to the Association on the anesthetic value of the magnesium salts. Dr. Meltzer incidentally mentioned that Dr. Peck of New York City had already operated his third successful case under magnesium sulphate anesthesia, administered intravenously. One of these operations was a double herniotomy. He pleaded for caution in the use of this new method of anesthesia until an absolutely fool-proof method of administration had been devised. The value of the magnesium salts in tetanus was also emphasized.

The following new members were admitted: Drs. Chas. Cabalzar, Indianapolis; E. L. Brady, Marion, O.; Samuel Johnston, Toronto, Can.; Albert Ehrenfried, Boston; Wm. Branower, New York City; Geo. P. Tolman, Watsonville, Cal.; Lillian B. Mueller, Indianapolis; Abram Liebovitz, New York City; R. S. Adams, San Antonio, Texas; A. V. Wenger and John H. Evans, Buffalo, N. Y.; E. Klaus, Cleveland, O.; Edw. Remy, Jr., Mansfield, O.; Ritter Daniel, Punxsutawney, Penn.; Lincoln F. Sise, Boston; Reuben Mauretts, Grand Rapids, Mich.; H. M. Spofford, Batavia, N. Y.; R. Goodloe McGahey, Birmingham, Ala.; J. E. H. Atkeisson, Chicago, Ill.; Worth E. Yankey, Atlanta, Georgia; Lloyd R. Allen, Colorado Springs; Layman S. Hapgood, Cambridge, Mass.; T. A. Dean, Casper, Wyoming; Alex. S. McCormick, Akron, O.; Mary Mulcahy, Chicago, Ill.; Edw. L. King, New Orleans; Frances Haines, Chicago, Ill.; Myra E. Babcock, Detroit, Mich., and Clarence L. Candler, Detroit, Mich.

The Association Banquet was served in the Roof Garden of the Hotel Tuller and was a very delightful affair. Dr. Gatch, the retiring President, acted as Toastmaster. Dr. Clarence L. Candler spoke on "Detroit the Dynamic." Other speeches were made by Drs. Boothby, Nagel, Ehrenfried, McKesson, Mytinger, Herb, Remy, McLean and McMechan in a discussion of the policies of the Association. A committee consisting of Drs. Boothby, Isabella C. Herb and F. W. Nagel was appointed to investigate the teaching of anesthesia in medical schools and colleges and to report on some plan for advancing such teaching and also in establishing some uniform method of training internes in the hospital anesthetic service.

The next meeting will be held just previous to the A. M. A. meeting in New York City, 1917.

SECOND ANNUAL MEETING INTERSTATE ASSOCIATION OF ANESTHETISTS.

A great deal of interest is being manifested in the Second Annual Meeting of the Interstate Association of Anesthetists in Louisville, Ky., July 26 and 27, in conjunction with the National Dental Association.

Aside from the regular scientific sessions, the Joint Meeting with the National Dental Association in a Special Section on Anesthesia for Oral Surgery, and an Historical Section, interspersed with a delightful musicale, are two features of the meeting that are attracting widespread attention.

Also the Association Dinner on the evening of July 26, at the Hotel Seelbach, will be an enjoyable event. Dr. F. G. DuBose of Selma, Ala., the inimitable teller of "colored anecdotes," will be toastmaster and will deliver "Some Smokes." Dr. G. A. Hendon of Louisville, Ky., famed as one of the postprandial celebrities of the Blue Grass region, will dilate on "Lightningbugs," and express his opinion of people who carry their headlight on behind. That genial dentist, Dr. John R. Callahan of Cincinnati, will forsake research for the nonce and put-over some "Jaw-Breakers," including the one about octogenarian optimist, who was worse afflicted than Job, but more patient and happy because he still had two teeth, and thank God! they hit. Mrs. Laurette McMechan will discourse on almost everything from "Soup to Nuts," while Dr. George F. Butler of Mudlavia will bespatter the subject of "Woman's Rights—or Privileges," with several tons of mud, impregnated with his usual number of scintillatingly intellectual maché units of unadulterated radium sulphite.

Dr. A. L. Henderson, Atherton Bldg., Louisville, Ky., will co-operate with those who have not yet made their hotel reservations.

For further particulars and Dinner Reservations, address F. H. MCMECHAN, M.D., *Secy.-Treas.*, Avon Lake, Ohio.

PROVIDENCE (R. I.) SOCIETY OF ANESTHETISTS.

The meeting of February 17, 1916, was called to order by Dr. A. H. Miller, the President. The question of changing the qualification of membership was raised and discussed. As it is now, active members are limited to those on the staffs of the various hospitals or those qualified as specialists in anesthesia. Associate members might be any others who were interested in anesthesia. The question was laid on the table for future consideration.

The following officers were elected: Dr. Raymond C. Bugbee, President, and Dr. B. H. Buxton, Secretary.

Dr. A. H. Miller then read a paper on Nitrous Oxid-Oxygen Anesthesia: With Description of a New Apparatus (herewith printed in the Supplement). A general discussion of the subject followed, in which

Dr. L. Kingsman spoke of the usefulness of nitrous oxid-oxygen in short anesthesia, especially in office work. As a routine of anesthetic, its cost and the necessity for expert administration, millitated against its use.

Dr. Charles O. Cooke spoke of Dr. Crile's experiments with nitrous oxid on dogs, and of his conclusions that there was less shock from this method of anesthesia than any other. He also emphasized the advantages of the preliminary use of morphin.

Dr. Eddy mentioned his personal experiences with nitrous oxid-oxygen in dentistry; also the use of air and oxygen. He detailed the technic of self-administration with the nasal inhaler and reported very satisfactory results.

Dr. E. Porter detailed his experiences with nitrous oxid in obstetrics, emphasizing its utility in normal as well as instrumental deliveries.

Dr. Miller then gave statistics of some 200 cases observed in regard to post-operative nausea and vomiting. The cases in which straight nitrous oxid-oxygen or straight ether were administered, showed less vomiting than other mixtures, combinations and sequences.

Dr. Adams, from a consideration of 50 cases, corroborated Dr. Miller's findings.

A collation followed the scientific program.

B. H. BUXTON, M.D., *Secretary.*

CAUDAL ANESTHESIA IN GENITO-URINARY SURGERY.*

BRANSFORD LEWIS, B.S., M.D., F.A.C.S.,
and
LEO BARTELS, M.D., F.A.C.S.,
Genito-Urinary Surgeons to St. John's Hospital,
ST. LOUIS, MO.

In the field of genito-urinary surgery particularly, we have felt the need of a satisfactory anesthetic—one that will carry the aged and decrepit prostatic through his operative crisis, for instance, without adding to his enfeeblement or increasing his sufferings. Spinal anesthesia was proposed as a boon in this direction, but has been found woefully lacking in safety. We consider it the most dangerous of all methods of anesthesia in such cases.

Working on the allusion to sacral anesthesia given by M. L. Harris ("Nerve Blocking," Surg., Gyn. and Obstetr., February, 1915) during the past eight months, we have studied the regional anesthesia (analgesia) of the pelvic organs contributed by infiltrating the sacral nerves as they lie within the sacral canal, and our results have been strikingly successful from our standpoint and so gratifying to the patients that we are impelled to present them, anticipating its adoption by the profession when it becomes more widely understood and used.

ANATOMICAL CONSIDERATIONS.

Spinal Nerves.—There are thirty-one pairs of spinal nerves. Leaving the cord, they emerge from the bony enclosure through the interverebral foramina on each side, and are thence distributed to their several destinations in the body. The spinal nerves are divided into five groups—the cervical, dorsal, lumbar, sacral and coccygeal.

The Sacrum.—Although composed of separate segments (vertebræ) in early life, the sacrum becomes blended into one bone in the adult. For present consideration its most interesting features are its *central canal* and *foramina.* The canal is a continuation of the spinal canal above. It lodges the sacral nerves, which pass through the several anterior and posterior foramina of the bone. The anterior group, converging and running forward within the pelvis on the surface of the pyriformis muscle, forms the *sacral plexus.* Its ultimate distribution is to structures of the pelvis and lower extremities, parts of the body that are rendered amenable to local or regional anesthesia by methods about to be considered.

The central or sacral canal is enclosed in bony walls except at its lower end; here, through non-development of the foramina and spinous processes, the posterior bony wall is lacking and is replaced by a ligamentous covering. This is the sacral hiatus. Through this ligamentous covering is introduced the hypodermic needle that is to convey the fluid for anesthesia. Occasionally the canal is left open for nearly the lower half of the sacrum, offering a larger opening for the puncture by the needle. Sometimes, on the other hand, it is covered almost to the lower end, and narrows the field of accessibility.

Caliber and Curve of the Canal.—The canal is triangular in form and relatively large above, grows smaller and flattened below. It follows the forward curve of the sacrum, which is variable in different subjects and in the sexes. In the male the curvature is more evenly distributed over the whole length of the bone, and is greater than in the female, while in the latter the bone is projected more obliquely backward for the increase of the pelvic capacity pertaining to that sex. These variations also may have an influence on the ease of introducing a straight hypodermic needle, the axis of the curve having to be threaded by compensating movements while advancing the needle.

Distribution of the Nerves from the Sacral Plexus.—The chief divisions of the sacral plexus are the sciatic and pudic nerves. The pudic terminates in three branches: (1) The dorsal nerve of the penis; (2) the perineal nerve, and (3) the hemorrhoidal. These supply the skin and structures of the penis, scrotum, perineum and anus, the muscles of the urethra, perineum and prostate and bladder, and inner surface of the thighs.

PREPARATION OF SOLUTION.

In our work with caudal analgesia we have used various drugs as aids in local analgesia, such as the magnesium salts, potassium sulphate, calcium chlorid and adrenalin. The magnesium salts were successfully used in spinal anesthesia for a while, but later gave way to the more effective analgesic drugs. For caudal analgesia they were not satisfactory. Calcium chlorid was used in conjunction with novocain, chloretone and adrenalin by Harris. He used the calcium chlorid to prolong the analgesic properties and adrenalin was used for the same purpose. Potassium sulphate was used by Hoffman to prolong the analgesic properties of the various drugs so used, and, in our opinion, it is the most successful in lengthening the duration of analgesia. By adding potassium sulphate to the analgesic fluid a much weaker novocain solution than otherwise can be used. Adrenalin is also used for retaining the effects of the drug. Adrenalin must be added to the solution just before using it, as it is unstable and becomes ineffective if added and allowed to stand for over two or three hours, as indicated by the solution turning a reddish-brown color. In addition, chloretone has been added to the solution to the point of saturation, which is eight-tenths of 1 per cent. This drug although a local anesthetic and a marked antiseptic, has been discontinued by us because of its irritating effects upon the tissues injected and also because analgesia has seemed just as good without it. The preparation of the solution seems a simple matter, but the fact that the action of the novocain may be lessened by the addition of other drugs to the solution impels us to take the extra precaution of making up separate solutions—novocain, 1 per cent.; potassium sulphate, 1 per cent.—combining them in equal quantities at the time of operation. The combined solution contains a half of 1 per cent. each of novocain and potassium sulphate, to which one or two drops of adrenalin are added to each thirty cubic centimeters of solution. In making the solution, freshly distilled sterile water should always be used.

HISTORY AND PROGRESS OF EPIDURAL SACRAL ANESTHESIA OR CAUDAL ANALGESIA.

Epidural injections were first used by Cathelin, of Paris, in 1901. He conceived the idea of medicating the nerves in this region for various pelvic neuroses, as neuralgia, sciatica and urinary incontinence. The solutions that he used ranged from sterile water to saline solution containing various local analgesic drugs. One to eight ounces of solution could be used and the injection was repeated several times. His results in urinary incontinence, though hard to explain, were very good.

In 1910, Läwen began a systematic application of Cathelin's epidural injections with considerable success.

* Read before the Mississippi Valley Medical Association, October 19-21, 1915.

Later Bull used it sixty-four times. He injected through the caudal hiatus, using 20 c. c. of a 2 per cent. of novocain solution with epinephrin. His results were very good in forty-seven cases, but in 15.6 per cent. of the cases no analgesia was produced.

SUCCESS AND FAILURE.

The difficult cases for this method are the obese, the very nervous, the hysterical and children. Läwen has advised against its use in the elderly, but we have found it particularly advantageous for them. However, the nervous type of patient should have a preliminary sedative, such as pantopon, grain one-third, hypodermatically, which we have used with eminent success. The use of caudal analgesia is not contra-indicated in those children who are susceptible to reason. Very fleshy women are most difficult to work with, owing to the increased adipose tissue over the sacrum, obscuring the anatomical landmarks.

TECHNIC FOR CAUDAL ANALGESIA.

The patient is placed on the right side with head slightly elevated and is instructed to bow the back by bringing his knees and chin as closely together as possible. The area over the sacrum, buttocks and lower lumbar region is cleansed with benzine, dried and painted with iodine solution.

Having first infiltrated the skin area over the lower end of the sacral canal or caudal hiatus with a few drops of the analgesic fluid, the long needle fitted with trocar wire is inserted into the hiatus. This opening is sought for with the finger and is always found just below the last sacral spine or lower end of the tubercular ridge, and usually just above the articulation of the sacrum and coccyx. The rudimentary spinal processes of the sacrum can usually be easily differentiated. The first is very prominent and distinct from the others; the second and third may be separate, but are usually united into a ridge running downward. The fourth almost always and the fifth always remains undeveloped. The remaining gap resulting from the failure of the laminæ to meet in the midline is called the sacral hiatus and is covered by ligaments which may readily be felt while introducing the needle at this point. Owing to the variations in the curve of the sacrum in different individuals there can be no fixed angle designated as formed by the needle and the surface of the body at the point of injection. However, it is always more than a right angle with the body surface above the sacral hiatus. Latterly we have been using a curved needle. The curved needle is an improvement over the straight needle in that by merely turning the needle from side to side the analgesic fluid can be accurately applied to the sacral nerves as they emerge from the anterior foramina on either side. When using the curved needle half the desired quantity is injected on one side; it is then turned toward the opposite side and the remainder is injected. The curved needle has another advantage over the straight needle in that it can be made to follow a more sharply curved sacral canal which might not be permeable to the straight needle.

The needle used should be at least four to five inches in length and not of too large caliber. It is inserted upwards into the sacral canal for two or two and one-half inches.

Before injecting the analgesic fluid we must be sure that the needle has not entered the spinal canal or one of the large veins constituting the plexus about the cauda. If the spinal canal has been entered spinal fluid will usually escape after the withdrawal of the obturator from the needle, while, on the other hand, if a vein has been punctured blood will drop from the needle. If neither blood nor spinal fluid escape, the analgesic fluid still should not be injected until we have tested the location of the end of the needle by injecting a few drops of normal saline solution through it. The authors have had a very unpleasant warning on this point which could have been obviated by such preliminary injection of saline solution. In this case the needle was introduced in the usual manner and injection was begun, but after about 10 c.c. was injected the patient complained of weakness, extreme pain in the head and chest, and his pulse became somewhat weak and irregular. The injection was stopped at once, and, on detaching the syringe, blood was seen to run from the needle. The patient soon recovered and left the hospital about three hours later, feeling very well. In this case the needle had entered a vein, but the blood was retarded from flowing out by a small clot or piece of tissue which had occluded its lumen. If saline solution had been injected before using the analgesic fluid the obstruction plug would have been washed out and the blood escaping from it would have indicated a vein had been entered. If either the spinal canal or vein has been punctured the position of the needle should be changed before injecting the analgesic fluid. Having the needle properly placed, 30 to 90 c.c. of analgesic fluid is slowly injected. Analgesia becomes complete in from ten to thirty minutes, and lasts several hours. By increasing the quantity of fluid the entire sacral plexus may be included.

BROADENING OF THE FIELD OF OPERATING FOR GENITO-URINARY SURGERY.

To the genito-urinary surgeon this method of analgesia is especially valuable in that it may not only be used for those painful cystoscopies which are otherwise so difficult and unsatisfactory, but by increasing the amount of solution injected it is used for perineal and supra-pubic operations on the bladder and other such major surgery.

Caudal injection does not give analgesia above the symphysis; therefore, in doing supra-pubic cystotomy it is necessary to employ direct local infiltration of the abdominal wall until the bladder is reached, but it will be found that the analgesia will be sufficient from here on to enucleate the prostate or do any other surgical work about the bladder.

We have used this method seventy-six times in work ranging from cystoscopy to external urethrotomy and supra-pubic prostatectomy, with exceedingly gratifying results.

To estimate the important advantages of caudal analgesia we must compare it with other forms of anesthesia, such as that from chloroform, ether, nitrous oxid, nitrous oxid and ether, and spinal anesthesia. Chloroform, excepting in obstetrical work, has practically been discarded on account of its dangers. Many obstetricians no longer make use of it. Nitrous oxid, combined with ether when necessary, is recognized as being the safest anesthetic when given by an expert. Spinal anesthesia, essentially a local anesthesia, still has its adherents and is still used extensively by some surgeons. But the popularity of this method has had a sudden rise and likewise a sudden fall. From our experience and that of surgeons with whom we have conferred, we consider this the most dangerous of all methods of anesthesia. When spinal anesthesia works well and proves safe it is all that can be desired of anesthesia. But when its danger signs once become evident, we are more helpless than in any other form of anesthesia.

It must be admitted that in some surgical clinics N_2O-O, alone or with ether, is proving itself a very safe and satisfactory method of anesthesia for bad risks.

There have been no bad results or fatalities reported following the use of epidural injections, sacral anesthesia or caudal analgesia.

ADVANTAGES.

The chief advantages of caudal analgesia are: Extreme safety and absence of unpleasant or dangerous after-effects, as nausea, vomiting, pneumonia, etc. It has enabled us to operate on a class of patients in whom the risk of using general anesthesia would have been too great.

We have been so well impressed with the success of the method during six months' use of it that we believe it is destined to change largely the surgery of the pelvis, especially for the aged, feeble and decrepit. Prostatectomy is at once relieved of one of its greatest objections. The patient goes through the operation without shock, without nausea or vomiting, without menace to heart or lungs, and may be as comfortable after its performance as he has been before it.

The term analgesia as applied to this procedure has been used in preference to anesthesia. In many cases tactile sensation is not completely lost, though pain in the same area is entirely abolished.

Newer Apparatus

PRACTICAL ANESTHESIA, SHOWING A NEW ETHER APPARATUS.*

By Ben Morgan, M.D.,
Chicago, Ill.

We have long noted that the deleterious after-effects of an ether anesthesia are in proportion to the ease with which that anesthesia is induced, and the steadiness with which it has been continued during the operation. The minimum amount of anesthetic used to keep the patient in the best possible condition for the operator to do his work is the object we wish to attain in the use of ether. To this end the condition of the ether as it reaches the respiratory tract is of the utmost importance. Only pure ether vapor mixed with proper proportions of pure air should enter the patient's respiratory tract, and the minimum amount of this mixture should be used. Ether vapor raised slightly in temperature has been shown to be very important, in order that the after-effects of the anesthetic shall be minimized, namely, shock, nausea and vomiting, excitability and a prolonged unnecessary sleep after the operation has terminated. To accomplish just these points has consumed no little attention of surgeons and anesthetists throughout the world. Various devices have been constructed, which are complex, expensive, fragile and bulky. Some of these devices entail an expense of two or three hundred dollars, and are almost too large for transportation.

I have here an apparatus, constructed upon the basis of simplicity, durability, portability, efficiency and economy.

The large evaporating chamber affords enough evaporating surface to give concentrated ether vapor sufficient to anesthetize any patient. Ether vapor is now concentrated, and it only remains to pipe this vapor to the patient's respiratory tract. The power used to transport this ether vapor to the patient's respiratory tract is furnished by the patient himself. The stimulating effect of the ether upon the respiratory tract offsets whatever overwork there may be produced by the inhalations of the patient through the apparatus.

Of course, this ether vapor is too strong to begin the induction of anesthesia, and some means of regulation must be established. On the face inhaler there is an ordinary air-valve, which, when opened, admits pure air, with possibly only a trace of ether vapor. When the valve is closed, the concentration of ether vapor is equivalent to that of a strong drop method. Any point between open and closed represents the percentage of pure air to ether vapor. Two other valves, one on the face inhaler, the other in the aluminum casting, are so arranged that only a one-way flow of the ether vapor is possible. The inside diameter of the valves and tubing is large enough to minimize the resistance of the passage of air through the apparatus. By means of this one-way flow of ether vapor, there is no rebreathing.

This feature of no rebreathing I claim to be a most important point in ether anesthesia, and present the records of thousands of soldiers and over two thousand hospital patients as proof. That is to say, rebreathing in an ether anesthesia is wrong in principle, wrong in practice, and should be abandoned.

The fact that rebreathing vitiates the air in assembly halls is so well-known that laws have been enacted to enforce proper ventilation, when more than 2/100 of 1 per cent. of nitrogenous product is discovered in this air. Why should we, then, as sanitation experts, fall behind in the science of ventilation and use antiquated methods, with their closed rubber masks, and the consequent rebreathing, in so important a field as anesthesia?

The four jar mouse experiment shows what it will do for the poor mouse. When the exhaled air containing carbon dioxid and the nitrogenous excretion is passed simultaneously from mouse No. 1 to mouse No. 4, No. 4 dies. But if we add to No. 4 pure carbon dioxid in quantities double that in the first condition, he lives and does well on it. Thus, carbon dioxid is a respiratory stimulant, and is all right to use in skilled hands, but that carbon dioxid should not be from the exhalation of the patient, contaminated with the poisonous nitrogenous output of the lung.

With this apparatus, rebreathing is impossible. It remains to show the result of the use of this or any other device which will enable us to deliver to the patient pure, unadulterated ether vapor, mixed in the proper proportions with pure air.

Referring to the cases in which this method has been used, the results are as follows: The induction of the anesthesia is practically without excitement or struggle; secretions from the mouth are practically *nil;* a normal color is maintained throughout the operation; the patient wakes up very shortly after returning to bed, and nausea and vomiting do not exist in more than 7 per cent. In only one case has there been nausea extending over an hour, where the operation was not that of gastro-enterostomy, or abdominal work accompanied with much intestinal irritation. This was a case operated upon for appendicitis last week. She gives a history of becoming nauseated whenever she endures any form of pain. Her headaches are all sick headaches. Therefore, to causes other than the anesthetic, the nausea following the operation may be attributed.

By this method the amount of ether required is about 40 per cent. of that by the drop method, even when the drop method is used by an expert.

The method had its birth with some extensive experiments in dog surgery. Being handicapped by not having an anesthetist to keep my dog asleep, I found a substitute necessary, and constructed a device which worked, but was a makeshift. In this first apparatus the exhalation went out through the source of supply, that is, the evaporating chamber, and into the room, wasting much ether. A Y-shaped intubation tube with air valves, similar to those on this apparatus, with a regulating device to admit more or less free air, kept the dog anesthetized for three or four hours without further attention to the anesthetic. This proved so satisfactory that it was used by Dr. Axel Werelius, of the South Shore Hospital, Chicago, who was the first surgeon to permit this apparatus to be used in his work. After repeated failures in completely anesthetizing the patient, a large evaporating chamber was used, and results most promising were accomplished. It was next used at the Cook County Hospital, by Dr. Lawrence Ryan, in a few of the alcoholics, with good results. This was about the time of the beginning of the war, and, feeling that the war zone presented a large field for anesthetics, I went to Belgium with the German Army, and gave thousands of anesthetics to wounded soldiers. The finer qualities of the apparatus and the method were added when use with this vast material proved their value.

* Read before the Mississippi Valley Medical Association, Lexington, Ky., October 19-21, 1915.

TO READERS OF THE SUPPLEMENT

¶ While the pages of the Supplement are replete with invaluable suggestions for advancing the science of anesthesia and analgesia, the advertising sections of the American Journal of Surgery contain many valuable pointers regarding apparatus, drugs, agents, and accessories that fulfill many of the requirements in the practice of these specialties.

It will be of interest then to the readers of the Supplement to refer to these advertising sections for anything they may need in the practice of their specialty.

Index and Abstracts

A Résumé of the International Current Literature of Anesthesia and Analgesia

EDITOR'S NOTE: Authors of pertinent articles, who desire to have them indexed and abstracted, are cordially invited to send copies of the journals containing their contributions, direct to the editor, immediately on publication. Also the receipt of reprints for filing and reference will be duly appreciated.

ANESTHESIA AND ANALGESIA IN OBSTETRIC PRACTICE. Arthur J. Skeel, Cleveland O. Journal of the American Medical Association, March 11, 1916.

ANESTHESIA, DIAGNOSTIC METHODS OF. F. A. Faught, Philadelphia, Pa. New Jersey Dental Journal, December, 1915.

ANESTHESIA FOR ENUCLEATION OF TONSILS. J. Blumfeld, London. Lancet, April 8, 1916.

ANOCI-ASSOCIATION. C. N. Cowden, Nashville, Tennessee State Medical Association Journal, April, 1916.

ANOCI-ASSOCIATION, A PLEA FOR SURGICAL PATIENTS. A. B. Cooke, Los Angeles. California State Journal of Medicine, February, 1916.

APPARATUS FOR THE ADMINISTRATION OF GAS-OXYGEN. W. Walter, Chicago, Ill. New York Medical Journal, February 19, 1916.

CAUDAL ANESTHESIA IN GENITO-URINARY SURGERY. B. Lewis and L. Bartels, St. Louis. Surgery, Gynecology & Obstetrics, March, 1916.

DENTIN, INNERVATION OF. J. H. Mummery, London. The Dental Cosmos, March, 1916.

ETHER AND CHLOROFORM, INDICATION AND CONTRAINDICATIONS FOR. W. W. Phillips, Roswell, N. M. New Mexico Medical Journal, April, 1916.

ETHER VAPOR, USE OF WARMED, FOR ANESTHESIA. F. B. McCarty and B. F. Davis, Chicago. Annals of Surgery, March, 1916.

ETHER, THE ANTISEPTIC ACTION OF IN PERITONEAL INFECTIONS. John Saliba, Elizabeth City, N. J. Journal of the American Medical Association, April 22, 1916.

ETHER, UNDER. Personal Experiences During an Operation. J. M. Synge. Interstate Medical Journal, January, 1916.

ETHER, SIMPLICITY IN ITS ADMINISTRATION. Isabella C. Herb, Chicago, Ill. Journal of the American Medical Association, April 29, 1916.

ETHYL CHLORID ANESTHESIA IN HANDLING THE WOUNDED. A. Broca. Presse Medicale, February 3, 1916.

ETHYL CHLORID ANESTHESIA IN WAR SURGERY. J. Charles and A. Charrier. Journal de Medicine de Bordeaux, January, 1916.

HYOSCIN-MORPHIN ANALGESIA, OR NARCO ANESTHESIA; EXPERIENCES WITH. Spencer R. Stone, Atlanta, Ga. American Journal of Surgery, January, 1916.

LOCAL ANESTHESIA. G. Aud, Louisville. Kentucky Medical Journal, April, 1916.

LOCAL ANESTHESIA. G. MacGowan, Los Angeles. California State Journal of Medicine, January, 1916.

LOCAL ANESTHESIA. L. E. Daugherty, St. Paul. Journal-Lancet, February, 1916.

LOCAL ANESTHESIA: ANATOMY OF THE ORAL CAVITY IN RELATION TO. Hugh W. MacMillan, Cincinnati, O. The Dental Summary, March, 1916.

LOCAL ANESTHESIA, PROSTATECTOMY UNDER. A. E. Hertzler, Kansas City. Journal of the American Medical Association, April 29, 1916.

LOCAL ANESTHESIA, SUPRA-PUBIC PROSTATECTOMY UNDER R. L. Payne, Norfolk, Va. American Journal of Surgery, March, 1916.

LOCAL ANESTHESIA IN NOSE, THROAT AND LARYNX OPERATIONS. Myron Metzenbaum, Cleveland, O. Ohio State Journal of Medicine, April, 1916.

LOCAL ANESTHESIA FOR EXTENSIVE VAGINAL OPERATIONS. H. Thaler. Monatschrift f. Geburtshülfe u. Gynekologie, November, 1915.

LOCAL ANESTHESIA, APPENDECTOMY UNDER. Jos. Weiner, New York. Journal of the American Medical Association, April 8, 1916.

LOCAL ANESTHESIA, EXTENDING THE FIELD OF. T. Iversen. Ugeskrift for Laeger, Copenhagen. February 17, 1916.

LOCAL ANESTHESIA FOR PROSTATECTOMY. F. Legueu. Bulletin de l'Academie de Medicine, April 4, 1916.

LOCAL ANESTHESIA, LAMINECTOMY UNDER. A. C. Strachauer, Minneapolis, Minn. Journal-Lancet, February, 1916.

LOCAL ANESTHESIA IN ABDOMINAL SURGERY. J. H. Jacobson, Toledo, O. Michigan State Medical Society Journal, February, 1916.

LOCAL ANESTHESIA IN DENTISTRY. B. H. Johnson, Nashville, Tenn. The Dental Summary, February, 1916.

LOCAL ANESTHESIA, OPERATIONS WITH ON THE EXTERNAL GENITALIA AND PROSTATE. A. C. Stokes. The Urologic and Cutaneous Review, February, 1916.

LOCAL AND GENERAL ANESTHESIA IN MASTOID OPERATIONS. T. W. Moore, Huntington, W. Va. Southern Medical Journal, April, 1916.

LUNG SURGERY, EXPERIMENTS IN. C. George, Jr., Ann Arbor. Michigan State Medical Society Journal, March, 1916.

LUNG, RESECTION OF, ARTIFICIAL PNEUMOTHORAX IN EXPERIMENTAL RESEARCHES ON. W. Fenger. Hospitalstidende, February 2, 1916.

MAGNESIUM SULPHATE, INHIBITORY PROPERTIES OF AND THEIR THERAPEUTIC APPLICATION IN THE TREATMENT OF TETANUS. S. J. Meltzer, New York City. Journal of the American Medical Association, March 25, 1916.

MAGNESIUM SULPHATE, INTRAVENOUS INJECTION OF FOR ANESTHESIA IN ANIMALS. J. Auer and S. J. Meltzer, New York City. Journal of Experimental Medicine, May, 1916.

MORBIDITY, SURGICAL PROBLEMS, CONSIDERED FROM THE VIEWPOINT OF. E. H. Ochsner, Chicago. Illinois Medical Journal, March, 1916.

NERVE BLOCKING IN LABOR. R. W. King, Salt Lake, Utah. Northwestern Medicine, April, 1916.

NITROUS OXID-OXYGEN ANALGESIA IN LABOR. W. C. Danforth, Evanston, Ills. Surgery, Gynecology & Obstetrics, March, 1916.

NITROUS OXID-OXYGEN ADMINISTRATION, NOTES ON. R. C. Coburn, New York City. Journal of the American Medical Association, March 11, 1916.

NITROUS OXID-OXYGEN ANALGESIA IN OBSTETRICS. Palmer Findley, Omaha, Neb. International Journal of Surgery, January, 1916.

NITROUS OXID-OXYGEN ANALGESIA IN EYE, EAR, NOSE AND THROAT SURGERY. W. Walter, Chicago, Ill. Opthalmology, April, 1916.

PAINLESS CHILDBIRTH. L. Burkhardt, Indianapolis. Indiana State Medical Association Journal, April, 1916.

PREPARATION OF PATIENTS FOR SURGICAL OPERATIONS. F. L. Potts, Spartanburg. South Carolina Medical Association Journal, April, 1916.

QUININ AND UREA HYDROCHLORID, USE OF AS A LOCAL ANESTHETIC, IN 148 CASES OF TONSILLECTOMY. L. J. Burns, Philadelphia. Annals of Otology, Rhinology and Laryngology December, 1915.

QUININ AND UREA HYDROCHLORID INJECTIONS IN HYPERTHYROIDISM. L. F. Watson, Oklahoma City, Okla. New York Medical Journal, April 22, 1916.

SCOPOLAMIN AND MORPHIN IN GYNECOLOGIC SURGERY. W. F. Morrison, Philadelphia. American Journal of Obstetrics, March, 1916.

SHELL CONCUSSION, CASE TREATED BY GENERAL ANESTHESIA. G. de H. Dawson. Lancet, February 26, 1916.

SHOCK, SURGICAL. R. D. Campbell, Grand Forks, N. D. Journal-Lancet, March 1, 1916.

SHOCK, CONDITION OF THE VASONCONSTRICTOR CENTER DURING THE DEVELOPMENT OF. G. Seelig and D. R. Joseph, St. Louis. Journal of Laboratory and Clinical Medicine, February, 1916.

TWILIGHT SLEEP AND CONVERSATIONAL ANESTHESIA. T. M. Burns, Denver, Col. Northwestern Medicine, April, 1916.

TWILIGHT SLEEP AND SCOPOLAMIN AMNESIA. C. A. Ferris, Denver, Col. Colorado Medicine, March, 1916.